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**JOINT FORCES STAFF COLLEGE
JOINT ADVANCED WARFIGHTING SCHOOL**

EDUCATION AND THE KNOWLEDGE MILITARY

by

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A paper submitted to the Faculty of the Joint Advanced Warfighting School in partial satisfaction of the requirements of a Master of Science Degree in Joint Campaign Planning and Strategy. The contents of this paper reflect my personal views and are not necessarily endorsed by the Joint Forces Staff College or the Department of Defense.

This paper is entirely my own work except as documented in footnotes.

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ABSTRACT

This thesis studies the impact of education on joint military operations. Education, as part of a knowledge military, is reviewed within the context of the historical characteristics of sea power as a case study. This study includes a review of Mahan's geographic and population characteristics of sea power introducing education as an additional population characteristic, a review of education philosophy, education trends, impact of education on the knowledge military, and the impact of the knowledge on the joint force. The United States, India, and China maritime forces are used to illustrate the importance of education, as part of a knowledge military, on the growing complexity of modern military operations and the impact of secondary education on National Military Strategy.

Thesis: Without a renewed emphasis on education standards, sufficient recruits capable of performing mission standards will not be available for the United States to retain a knowledge advantage over future competitors.

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Introduction

The complexity of modern military operations requires well educated and technically trained joint warriors capable of participating in a knowledge military. A knowledge military is one that is able to evaluate complex systems and situations to achieve superiority in war. Innovation and intuition, research and development, industrial infrastructure, and education are pillars of a knowledge military.¹ Among these education is essential as it enables the rest. Horses have been replaced by Humvees, reconnaissance scouts by unmanned aerial vehicles, and unassisted cannon by guided anti-ship cruise missiles with a commensurate leap in the knowledge required to maintain and operate these systems. This paper focuses on the impact of education on the joint force utilizing sea power as a case study on the requirements of a knowledge military. A warship's inability to meet a joint requirement, because of under-educated and trained sailors, would impact not only the United States' ability to project sea control, but also seriously hamper, if not prevent, follow-on land and air missions. The emergence of Chinese and Indian expeditionary capabilities, in particular sea power, across critical trade routes can only be balanced by a highly trained and professional United States military. Without a renewed emphasis on education standards, sufficient recruits capable of performing mission standards will not be available for the United States to retain a knowledge advantage over future competitors.

The technical complexity of modern warships and naval operations are an archetype example of the dependence on knowledge military operations. The

¹ Knowledge Military is an adaptation of The World Bank's Knowledge Economy. Pillars of a knowledge economy include education and training, information infrastructure, economic incentive and institutional regime, and innovation systems.

characteristics of sea power, proposed by Alfred T. Mahan in *The Impact of Sea Power Upon History 1660-1783*, are critical in understanding maritime strategy, but no longer fully encompass all characteristics required to project power in the maritime domain of the joint operating area. Additionally, as in all facets of a knowledge military, education is a required population characteristic to develop the human capital required to fight across the joint spectrum of modern warfare. In the case of sea power, modern warships require technically astute sailors to maintain and operate complex engineering and combat systems. A nation's public school system provides the foundation in literacy and numeracy that are prerequisites for military specific training.

Education is the foundation of a society. Thomas Jefferson, a leader among the Founding Fathers on education, espoused a universal public education to create a responsible citizenry.² The importance of a well educated populace is even more essential today than it was when Thomas Jefferson helped to found a great experiment in democracy, "as a society becomes more complex ... it is ...necessary to provide a special social environment which shall especially look after nurturing the capacity of the immature."³ Education's importance has grown beyond ensuring a well informed electorate to being essential for a knowledge military and the defense of the nation. In the face of negative education trends and external pressure from emerging peer competitors, the United States is being challenged as the world's preeminent military. Though a sufficient well educated population exists to man today's relatively small joint force, it will be increasingly difficult in coming years as the technology increases if the

² James Gilreath, *Thomas Jefferson and the Education of a Citizen*, (Honolulu: University Press of the Pacific, 2002), 22.

³ Thomas Dewey, *Democracy and Education*, (New York: The Macmillan Company, 1953), 27.

recruitable population decreases, especially if national interests required an overall increase in the size of the armed forces.

In the case of sea power, Mahan identified six characteristics which impacted the emergence of a nation as a sea power. He distributed the characteristics into two general categories, geography and population, with the former impacted almost solely by provenance and the latter partly by requirements of the former, but also as a measure of national will.⁴ Regardless of the geography, if a nation does not have a maritime heritage or the populace or governmental will to employ naval forces, it will not be a sea power. These characteristics continue to impact sea power today as they did in the later 19th Century but the revolution of capital ships from unassisted cannon fire to guided missiles has added the additional requirement of a highly educated, technically savvy sailor to the list of characteristics. Without the strong foundation provided by a quality secondary school system, the Navy cannot train sailors to maintain the highly complex engineering and combat systems on modern warships. A nation-state with a strong education system capable of producing a population with the technical skills to maintain and repair advanced systems without assistance from shore will have a decided advantage in naval engagements.

Fortuitous geography and a strong maritime heritage are no longer enough to ensure a population of sailors capable of manning a fleet in peace or war. It is now essential for a nation to have a quality education system. India and China have focused national human capital strategies to increase the output of their education system in terms of increased number of years of education and a growing emphasis on literacy and

⁴ Alfred T. Mahan, *The Influence of Sea Power Upon History 1660-1783*, (New York: Dover Publications, 1987), 29-69.

numeracy. As India and China increase focus, United States students continue to struggle with math and science placing in the bottom quarter and bottom third respectively relative to participating Organization for Economic Cooperation and Development Countries (OECD) in a 2006 international assessment.⁵ An increasingly diverse country, demographics are particularly important in understanding the data and crafting policy as a response to these trends. As systems become more complex, education will play an increasingly significant role on the balance of powers across key sea lanes. The impact of education and the knowledge military on the Navy pervades every facet of warfighting. This impact is not unique to the Navy, the entire military as well as the nation, is dependent on a well educated population. A study of maritime powers' approach to education is intended to examine the capacity to maintain and operate modern fleets as a case study of the education requirements of the joint forces.

⁵ Stephanie Baldi, Jin Ying, Melanie Skemer, Patricia Green, Deborah Herget, and Holly Xie, *Highlights from Program for International Student Assessment (PISA) 2006: Performance of U.S. 15 Year Old Students in Science and Mathematics Literacy in an International Context*, (Washington DC: National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education, 2007), 1. China and India are not members of the OECD and did not participate in the assessment.

Chapter 1

Education and the Global Commons

“A military is only as capable as its professionally-trained and educated officers and senior noncommissioned officers allow it to be... We must continually educate our leaders to think, and not just to do...A “cognitive” warrior knows how to acquire knowledge, process information from multiple sources, and make timely, accurate decisions in complex, ethically challenging and ever-changing environments.”¹

General James N. Mattis, USMC

Access to the global commons is critical to build and maintain economic and military power. This access is only established and sustained with educated servicemen and women participating jointly in a knowledge military. With over ninety percent of all cargo transported by ship, the sea lines of communication are a particularly vital global common. In his highly esteemed work, *The Influence of Sea Power Upon History 1660-1783*, Mahan attempted to identify the characteristics that provide the opportunity for nations to master the seas. He enumerated six characteristics that made a nation a sea power: Geographic Position, Physical Conformation, Extent of Territory, Number of Population, National Character, and the Character and Policy of Governments.²

The first three characteristics are a product of the geography of a nation and can only be changed through treaties allowing the use of another nation’s bases or the imperialistic acquisition of those bases through force. The latter three characteristics speak to the heritage and will of the population and can be shaped through domestic policy. Education is one of the vital domestic policies that greatly impacts the capacity to

¹ General James N. Mattis Commander of Joint Force Command, statement to the House Armed Services Committee, on March 18, 2009, http://armedservices.house.gov/pdfs/FC031809/Mattis_Testimony031809.pdf (accessed 31 December 2009), 19.

² Alfred T. Mahan, *The Influence of Sea Power Upon History 1660-1783*, (New York: Dover Publications, 1987), 29-69.

maintain and operate modern fleets and ensure access to the sea lines in support of joint forces.

The geographic position of a nation, its requirement to defend its borders by land, its position along trade routes, and its access to overseas bases plays a determining role in its control of the seas.³ A nation, like the United States, that is unlikely to be attacked along its borders has a freedom of space and resources to invest in a navy. It is only in the last sixty years that Washington's feared "overseas entanglements" required a large standing army and the significant expenses that accompany it.⁴ That is not to propose that the United States has always resourced a great navy. Throughout its history, the navy like the entire joint force, experienced an ebb and flow of funding as a "peaceful, gain-loving nation is not far-sighted."⁵ China and India are not as fortunate as the United States and require, vice maintain willingly, large standing armies to defend their borders from numerous challenges including each other. These requirements take away physical resources and require large investments in human capital all impacting their emergence as sea powers. It will be difficult for China and India in the long term, as it will be for the United States, to dedicate ever increasing portions of defense spending to their navies while maintaining tremendous armies to ensure territorial integrity.

Mass and concentration of force are indelible principles of war across the entire joint spectrum of conflict. The nation that is able to concentrate forces at a decisive point against a quantitatively or qualitatively inferior enemy is likely to win the campaign. If a nation's geography gives it access to its sphere of influence without the necessity to split

³ Ibid., 29.

⁴ George W. Washington, "George Washington's Farewell Address," *Philadelphia America Daily Advertiser*, September 17, 1796.

⁵ Mahan, 26.

its fleet it is advantaged in comparison to a nation that must maintain expensive logistical supply lines and lacks the ability to reconstitute quickly its navy to meet an enemy.⁶ In the current variably-polar world, the United States is uniquely disadvantaged in that its sphere of influence is global and therefore it must maintain a global fleet.⁷ The United States Navy is the largest in the world, but how fast could it concentrate the fleet if threatened from a modern navy? China and India due not currently seek influence significantly outside regional sea lines and do not maintain large fleets outside home waters. Without this requirement, China and India are able to balance multiple influences with a single navy. For China, it is the United States Navy and its allied navies in the Pacific and for India, it is Pakistan in the Indian Ocean and China in the Pacific, but due to geographic position this defense is effective in both cost and concentration.

Navies exist for the protection of commerce and the economy.⁸ If a nation state does not trade by the seas it has little use for a navy and the burden of its maintenance and upkeep. Access to trade routes both necessitates a navy and geographically advantages one nation over another in the ability to project power along the seas.⁹ Global trade routes shift over time as one natural resource becomes more or less important than others. Trade in spices, slaves, and precious metals created important sea routes that required defense from pirates and during time of war, privateers. Little has changed in the 21st Century other than the most prized commodity is now oil.

⁶ Ibid., 30.

⁷ RADM Chris Perry, RN, “Strategic Discussion” (lecture, Joint Forces Staff College, Norfolk, VA, December 10, 2009).

⁸ Mahan, 26.

⁹ Ibid., 31-33.

The United States is geographically positioned only to influence oil shipped to North America and without a preeminent navy could not impact the great trade routes in the Middle and Far East. With unique access to the India Ocean, India is positioned to observe seventy percent of the world's oil supply sail past its southern tip.¹⁰ India has little need for the foreign bases maintained by the United States and which China is eagerly attempting to gain access. United States bases in Rota, Djibouti, Bahrain, Diego Garcia, Guam, and Japan are expensive to maintain, but absolutely necessary to impact sea lines of communication. China's "string of pearl" strategy is clearly attempting to expand its influence in the increasingly important Indian Ocean.¹¹ Additionally, China's access to the Strait of Malacca, the busiest sea lane in the world, is essential not only to ensure access to raw materials, but in the ability to influence this essential trade route. As the importance of traditional sea lines in the Atlantic Ocean and Mediterranean Sea wanes, China and India's position along emerging trade routes position them to influence global commerce as long as oil is the world's chief commodity.

Access to overseas bases act both as a force multiplier and a strategic vulnerability. In order to support a large navy outside the geographic confines of one's own coast, overseas bases are an absolute necessity. They provide access to provisions, fuel, and repairs that are required to maintain operational availability. Conversely, overseas bases require political compromise with nations that do not necessarily share similar world views or desired end states. In areas with historical border sensitivities like the Indian and Pacific oceans, the compromise to attain base access may require

¹⁰ Robert D. Kaplan, "Center Stage for the Twenty-first Century," *Foreign Affairs* Vol. 88 Issue 2 (2009): 18.

¹¹ Ibid., 20.

antagonizing a third nation state that also has significant interests. China's decision to build a naval base in Gwadar, Pakistan is certainly of interest to India considering India and Pakistan's historical rivalries. In response to or at least in keeping with China's decision, India assisted Iran in the development of Chah Bahar Naval Station in the Gulf of Oman, which is negatively viewed in the United States. Increasing influence through the use of overseas bases may be viewed as a necessary evil, but one cannot ignore the strategic impact which may sometimes overshadow the benefit.

The second geographic condition affecting the development of sea power is the physical conformation of the nation state.¹² The "seaboard of a country is one of its frontiers" and the easier the access to this frontier through deep water ports the greater the ability to conduct commerce via the seas and the more probable a nation will embrace sea power.¹³ Commerce via sea lines, of course, is predicated upon having goods and services desired outside internal markets. The desirability of these goods and the manufacturing capability of a nation are interconnected to the development of sea power. Like in offensive land operations, there is a culmination point in the balance of commerce and sea power.¹⁴ A nation cannot maintain great commerce without the ability to defend its goods against piracy and aggressive nations, but there is a point where the development and maintenance of the navy requires greater resources than it generates through additional trade. In today's global trading environment, no nation can depend solely on its own navy for the defense of commerce leaving every nation that trades by sea inter-connected in mutual defense of the global economy.

¹² Mahan, 35.

¹³ Ibid., 35.

¹⁴ Carl Von Clausewitz, *On War*, (New York: Random House Press, 1993), 684.

Deep harbors continue to be a “source of strength and wealth,” but are no longer dependent solely on provenance; a nation can construct deep water ports where no internal navigable stream existed naturally.¹⁵ These ports are responsible for delivering the wealth of nations and are the catalyst for the global economy. The United States, India, and China all possess numerous deep water ports responsible for in excess of ninety percent of their external trade.¹⁶ Major and minor ports for internal and external trade dot all three countries sea boards. The strength and wealth provided by these ports can also be a weakness if not adequately defended.¹⁷ China and India have vast shore based anti-ship cruise missile capabilities to defend their shores against enemy combatants. The United States with two great oceans along its western and eastern borders relies on its naval forces and near certain air superiority in the Northern hemisphere for defense of its ports. Ports alone to do not provide wealth or trade, it is the commerce of a nation that flows through the ports that create wealth and increased standards of living. In a cyclical manner, excess goods can be sold to purchase foreign currency which in turn can be used to increase naval strength. No nation understands this formula better than China who built a world class navy in a relatively short period of time funded by excessive trade imbalances.

The United States and China conduct trade in the billions of gross tons annually with estimates for India in the half billion of tons range.¹⁸ Why then is India developing

¹⁵ Mahan, 35.

¹⁶ Kaplan, 18.

¹⁷ Mahan, 35.

¹⁸ Central Intelligence Agency World Fact Book, United States, China, and India Merchant Marine Data, <https://www.cia.gov/library/publications/the-world-factbook/geos/us.html>, <https://www.cia.gov/library/publications/the-world-factbook/geos/ch.html>, <https://www.cia.gov/library/publications/the-world-factbook/geos/in.html> (accessed November 2, 2009).

a navy to compete with China and the United States? The answer is more likely prestige and national security than the requirement to protect commerce. Without the requirement to maintain an expeditionary navy, India will be able to maintain interior lines in any probable naval exchange. China and certainly the United States will be required to maintain vast supply requirements on exterior lines.¹⁹ India is uniquely positioned to maintain sea power without requirements for overseas bases thus strengthening her interior lines against conflict to her east or west. The Straits of Hormuz and Malacca are critical choke points and of strategic importance to China and impose an expeditionary requirement for the Chinese Navy. China is dependent on open traffic through the Strait of Hormuz for fuel and through the Strait of Malacca for virtually everything else. These requirements are the impetus behind Chinese presence at Gwadar, Pakistan and its string of bases in the Bay of Bengal and will increasingly stretch the Chinese Navy.

The final geographic characteristic that affects the sea power is the extent of territory of a nation state.²⁰ As previously discussed, long coastlines with numerous deep water ports can be both a strength and a weakness to a nation that conducts commerce by the seas. It is a strength in time of peace as it allows the very trade that builds nations but during time of war it can be a vulnerability if it is not defensible. A coastline is defensible if a nation has the population and means by which to defend it against blockade and offensive mining. In terms of population, the United States and certainly India and China have sufficient personnel to adequately defend their coastlines. A decisive blockade, either through the use of surface combatants or offensive mining, would be improbable if not impossible with the number of deep water ports enjoyed by

¹⁹ Mahan, 40.

²⁰ Ibid., 42.

all three countries. The United States, India, and China all have adequate extent of territory to exert sea power in their home waters and also defend their coasts from attack in the case of defensive war.

Fortuitous geography to support sea commerce is not enough to develop sea power. A nation can have borders free from domestic dispute, numerous deep water ports, advantageous position along trade routes, and access to foreign markets and ports and still not develop sea power. If the population does not desire maritime industry and does not have a historical interest in the sea then it will not have a base to build sea power or a great navy. Mahan identified three characteristics of populace of a nation that impacted sea power, Number of Population, National Character, and the Character and Policy of Governments.²¹ These characteristics speak to the heritage of a nation and though favored towards nations that have historically gone “to the sea” can be impacted by domestic policy.²²

The United States inherited its maritime culture from England and through the ebb and flow of its history consistently depended on maritime commerce for the bulk of its trade. India, likewise, was a tremendous source of maritime trade with Europe starting in the 15th Century and magnified by its relationship with England and the East India Company.²³ Through the 19th Century, India was the terminus for the majority of cotton, silk, indigo dye, saltpetre and tea shipped to Europe from the Far East.²⁴ China did not enjoy the most favored trading relationship of India. China’s trade imbalance with

²¹ Mahan, 44.

²² St. Joseph Edition of the American New Bible Psalm 107-2. (New York: Catholic Book Publishing, 1991), 675.

²³ Sourendra N. Kohli, *Sea Power and the India Ocean*, (New Dehli: Tata McGraw Publishing: 1978), 3-5.

²⁴ Kohli, 7.

England and their strict anti-opium policy resulted in a Trade War in the early 19th Century which ended with Great Britain in control of Hong Kong. Though China might not have the maritime heritage of the United States or India they have, in recent years, been quick to engage in all things maritime. China's drive to increase its merchant fleet, modernize its port facilities, and expand its maritime workforce is impressive and crucial in its goal to be a sea power.²⁵

The first populace characteristic is the number of the population and the percentage of the population that is engaged in maritime enterprises.²⁶ A large population is certainly an advantage but the desire to impact the acquisition of wealth and national power via the seas is even more important. India and China, with populations over a billion each, have the population size to dominate the seas but do they have the means? What characteristics should one examine when reviewing the maritime population of a nation? Beyond the physical characteristic of its ports, a nation also requires merchant ships, trained sailors, and a shipbuilding and repair infrastructure to support growth in maritime commerce. While the United States has seen a decrease in domestically built and flagged vessels, China's shipbuilding industry is booming. China has three times as many registered ships than the United States and India and is continuing to increase in size.²⁷ The Chinese expansion "makes little sense from a purely economic perspective" since there is already an over capacity in shipping vessels only

²⁵ Baltic and International Maritime Council, "China's Merchant Marine," <https://www.bimco.org/Corporate%20Area/Education/Seascapes/Maritime%20Matters/Chinas%20Merchant%20Marine.aspx> (accessed November 2, 2009).

²⁶ Mahan, 44.

²⁷ Central Intelligence Agency World Fact Book, United States, China, and India Merchant Marine Data, <https://www.cia.gov/library/publications/the-world-factbook/geos/us.html>, <https://www.cia.gov/library/publications/the-world-factbook/geos/ch.html>, <https://www.cia.gov/library/publications/the-world-factbook/geos/in.html> (accessed November 2, 2009).

exacerbated by the current slow down in the global economy.²⁸ Their mercantilist approach to maritime shipping and government subsidies for ship building has generated concern in the industry. Where decreased regulation, low labor costs, and increased foreign investments created additional capacity in India and especially China, the United States' shipbuilding has been completed decimated by over-regulation and non-competitive labor costs.²⁹

India and China are well aware of the importance of maritime studies to support their growing commerce and significant research on the state-market relationship was conducted through the 1990s.³⁰ Trained merchant mariners are as important a commodity as ships or merchandise. The last decade has seen an increase in the institutions in China and India offering apprentice, journeyman, and master level educations in maritime studies.³¹ The United States does not have China or India's vast number of institutions but those it does have are some of the most advanced in the world administered by the federal government at King's Point and several state facilities as well as a hand-full of private schools.

A study of Chinese shipyards by the European Commission reported that "there has been a significant capacity expansion in recent years both through the construction of new facilities and the upgrading of existing shipyards."³² Though technology in China is lacking in comparison with the United States, they have not stopped expansion and seem

²⁸ William R. Hawkins, "How China Plans to Dominate the Shipbuilding Industry," *American Economic Alert* (2001), http://americanconomicalert.org/view_art.asp?Prod_ID=80 (accessed November 2, 2009).

²⁹ Hawkins.

³⁰ Faizal Yahya, "A Passage to India: India-Singapore Collaboration in Port Development," *Asian Studies Review Volume 27 Number 1* (2003): 2.

³¹ Hawkins.

³² Ibid.

intent on increasing outport on brute force³³ India has only 12 major ports and 139 minor ones in comparison to nearly ten times that many in the China or the United States. China, in particular, has used a diversified ownership structure that includes foreign enterprises and joint ventures to attract foreign investment greatly increasing their market share.³⁴ Overall, both United States and China have well developed port industries capable of supporting maritime commerce with India in the process of increasing capabilities.

The second of the populace characteristics that impact sea power is National Character.³⁵ There are characteristics that naturally give rise to sea power. The "tendency to trade", willingness to engage in open commerce, and a historical naval heritage all greatly affect the rise and endurance of sea power.³⁶ Of these traits, Mahan listed only the tendency to trade as a influential populace characteristic. He espoused the importance and benefits of colonialism for the development of sea power. Mahan explicitly criticized legislative hindrances in the United States that prevented the acquisition of colonies. Colonialism no longer has a place in the global economy and the acquisition of wealth from indigenous populations is out of vogue.

The pursuit of colonies was replaced with a global economy and a national willingness, for mutual benefit, to open markets for free trade. There is often a hesitancy to do so over fears over competition for "Made in" products but capitalist theorists such as Adam Smith showed that ultimately free trade is universally beneficial.³⁷ Along with

³³ Hawkins.

³⁴ Yahya, 10.

³⁵ Mahan, 50.

³⁶ Ibid, 53.

³⁷ Adam Smith, *The Wealth of Nations*, (New York, Penguin Publishing: 1982,) 10.

the economic characteristics that make up national identity and impact sea power one cannot discount a strong naval heritage. In this context, naval is meant to represent the heritage of an armed navy discreet from an overarching maritime history. Victory at sea is ingrained in the Royal Navy such that they cannot imagine defeat and this has a powerful impact on the fleet. Historically, great navies beget great navies which in turn continue to impact national character and the endurance of sea power. Enduring sea power ensures an enduring economy and the acquisition of wealth for a population.

Mahan described "the tendency to trade, involving of necessity the production of something to trade with, is the national characteristic most important to the development of sea power."³⁸ If a nation's wealth is not dependent on the movement of goods by way of sea lines then it has no impetus for the development of sea power. The economies of the United States, China, and India, are all dependent on wealth accumulated by sea trade. The United States with exports of 1.291 trillion dollars, China with 1.435 trillion dollars, and India with 176 billion dollars are all inextricably linked via the sea lines and without free trade would be unable to function as a modern economy.³⁹ This dependence is well understood in Delhi and Beijing with developed strategies to deal with Hormuz and Malacca dilemmas should free access be threatened by a hostile nation state or fundamentalist organization.⁴⁰ The United States is in the unenvied position of dependence on nearly all international choke points to guard its vital interests. United States, China, and India's maritime dependence creates a by default national character

³⁸ Mahan, 53.

³⁹ Central Intelligence Agency World Fact Book, United States, China, and India Export Data, <https://www.cia.gov/library/publications/the-world-factbook/geos/us.html>, <https://www.cia.gov/library/publications/the-world-factbook/geos/ch.html>, <https://www.cia.gov/library/publications/the-world-factbook/geos/in.html> (accessed November 2, 2009).

⁴⁰ Kaplan, 19-20.

that favors sea power though maritime and consequently naval heritage is historically stronger in the United States.

The naval heritage of a nation is the collective confidence in its armed navy based on a history of victory. There is no nation in the world with a more rich and intoxicating naval heritage than England. From the 1540s to 1940, on at least twenty-four occasions the Royal Navy saved England from invasion.⁴¹ The ideal that the seas of the world belong to Englishman is instilled in every sailor from the minute they walk across the brow. The entire empire was shocked when *USS Constitution* defeated *HMS Guerriere* in ship to ship combat during the War of 1812, a feat not accomplished in their collective memory.⁴² Since the War of 1812, the United States Navy has built its own naval heritage based on success in combat often against great odds. No battle, though there are many, illustrates better the resolve of the United States Sailor than Leyte Gulf. An overmatched Task Force of small combatants fought off the main body of the Imperial Japanese Fleet to ensure sea control for General MacArthur's amphibious landing force and the successful liberation of the Philippines.

All maritime nations understand in theory that "control of the sea means security. Control of the seas can mean peace. Control of the seas can mean victory."⁴³ It is how nations acted on this theory that impacts the development of sea power. The United States acted boldly in the tradition of its English predecessors. China is acting equally boldly in recent years to grow as a naval power but lacks a true naval heritage. The

⁴¹ Colin S. Gray, *The Leverage of Sea Power*, (New York: Macmillan Free Press, 1992), 66.

⁴² Ian W. Toll, *Six Frigates*, (New York: Norton and Company Publishing, 2006), 354.

⁴³ President John F. Kennedy, June 6, 1963, on board USS Kitty Hawk, *Public Papers of the Presidents of the United States: John F. Kennedy, Containing the Public Messages, Speeches, and Statements of the President, January 1 to November 22, 1963*, (Washington, DC: US Government Printing Office, 1964), 445.

Chinese Navy is still the People's Liberation Army (PLA) – Navy and at its core China is a continental nation with the largest standing army in the world. That is not to put forth that the PLA-Navy is not a well funded, serious fighting force just that they are not the historical central piece of Chinese military strategy like the Royal or United States Navy. India has acted less boldly and is only hesitantly reacting to the growing naval strength of their eastern neighbor. A strong naval heritage, a character of the both the people and the government, cannot be under-valued and in this sea power characteristic China and India remain untested.

The last element affecting sea power that Mahan examined was the character of the government. The government of a nation determines strategy and “naval strategy for its end to found, support, and increase, as well in peace as in war, the sea power of a country.”⁴⁴ Which form of government is most beneficial to the development and sustainment of sea power? There are advantages and disadvantages to each form of government so as to decidedly proclaim one form superior to another ill advised. In a democracy, it is the will of the people that influences policy and a “government in full accord with the natural bias of its people” supports the great expense required to maintain a navy will likely persevere.⁴⁵ Conversely, despotic powers with true insight and an effective strategy not subject to the mercurial nature democracy can create more quickly great sea power. The difficulty, in this case, is the willingness to persevere without true popular support.⁴⁶

⁴⁴ Mahan, 89.

⁴⁵ Ibid, 58.

⁴⁶ Ibid, 59.

The characters of government in the United States, India, and China are vastly different. The former two being democracies, they are greatly impacted by the will of the people and suffer the ebb and flow of funding based on the whims of government. The United States will likely reduce military spending as operations in Iraq and Afghanistan draw down. India, however, recently announced a thirty-four percent increase in military spending.⁴⁷ Chinese communist leadership is not subject to a vote of confidence in the government but still needs to account for the will of the people in drafting policy. The United States clearly has the most long standing strategy for the development and maintenance of a professional navy. The governmental support, however, for the Chinese Navy over the past two decades and India's Navy recently cannot be discounted in the emergence of naval power in these two quickly growing regional powers. This support goes beyond establishing the elements of sea power and naval force. China and India's support for education is inextricably linked with their pursuit of economic and naval power in a modern knowledge military.

Education, an essential population characteristic for participating in a knowledge military, has long been approached differently depending on the economic model of a nation state. Agricultural nations have different goals and requirements for their education systems than industrialized nations.⁴⁸ Developed, industrialized nations like the United States are reliant on education to ensure economic and social growth. Nations, like China and India, which are historically agricultural, have education systems built around the needs of a rural population. As they transition significant portions of their

⁴⁷ "India's New Defence Budget Pegged at \$28 Billion," India Defence Online, <http://indiadefenceonline.com/934/india%20%99s-new-defence-budget-pegged-at-28-billion>, (accessed January 19, 2010).

⁴⁸ Dewey, 9.

economy to manufacturing, it is essential to increase the quality and quantity of their education systems to compete economically, and militarily, with developed nations. Economically, education will be key to participating in a modern economy beyond low profit export production. Militarily, and specific to control of the sea lines, education is essential to maintain and operate modern military equipment in a knowledge military.

The transition from sail to steam sparked a period of on-going technological revolution in naval warfare. Naval engineering, combat systems, and weapons are all developing at ever increasing speed. This development dramatically increased the requirement for well trained sailors to operate and maintain these systems. In order to understand these complex systems, sailors need to have a well rounded education to allow them to participate in a knowledge military. A public education system is now a vital national interest and a key characteristic affecting military power.

Education is the process by which knowledge is passed from generation to generation. Humans are not born with the instincts of other animals and must learn in their youth the skills to survive both as an individual and a society. For a modern nation state, it is a robust public education system that ensures a knowledge base for its citizenry. General knowledge in subjects like math and science, provided by primary and secondary education, are the basis for post-secondary education in advanced fields from engineering, medicine, and business to the military sciences. A nation will not be able to participate fully in the modern world without a strong education system.⁴⁹ The pace of the global change is too great to entrust to the under or poorly educated. China and India have identified shortcomings in their own education systems and are taking proactive

⁴⁹ Fareed Zakari, *The Post-American World*, (New York: W.W. Norton Company (2008), 187.

steps to increase the quantity and quality of provided education. The United States, however, has one of the most comprehensive public education systems in the world, but continues to struggle with the quality of education provided. Nation states “demand teaching and learning for (their) own permanence” to safeguard their economy, their military, and their very way of life.⁵⁰

In agricultural communities, teaching and learning takes place through training and shared experience in the tasks actually to be mastered. As children come of age, they are taught the skills they need through taking part in the occupations of adults mostly outside the confines of formal education.⁵¹ This apprenticeship, journeyman, master process of education works well to develop physical skills and benefit a small community. The apprentice, journeyman, master system is unable, however, to prepare a child for the comprehension of the complex theories and systems required to participate in a knowledge military. Formal education prepares children to share in the greater community, “without such formal education, it is not possible to transmit all the resources and achievements of a complex society.”⁵²

Thomas Jefferson viewed an educated populace as a requirement for an enlightened and democratic society.⁵³ Public education existed in the United States from its founding and currently consists of twelve years of primary and secondary education. China and India have experienced tremendous growth in recent years and have placed renewed emphasis on universal education requiring nine and twelve years respectively.

⁵⁰ Dewey, 7.

⁵¹ Ibid, 9.

⁵² Ibid.

⁵³ Jennings L. Wagoner, *Jefferson and Education*, (Chapel Hill: The University of North Carolina Press, 2004), 31.

Their emphasis on “improving educational attainment is well-founded: a substantial body of research confirms the benefits of human capital accumulation for long-run economic growth, and emphasizes the contribution of educational attainment to higher wages and the improvement of other human development outcomes.”⁵⁴ Attaining this requirement, however, has been difficult due to the near cost of losing a hand in the field or factory. It will be essential for China and India to overcome internal resistance to education reform to have the well educated human capital capable of understanding complex engineering and combat systems.

The growing complexity of modern military systems requires a revolution in educational philosophy to compete for 21st Century national power. This revolution will have different conditions in the United States, China, and India but each country requires essential changes to focus primary and secondary education to meet future manpower requirements. Across the general conditions affecting sea power, the United States, China, and India are well positioned to maintain or emerge as great powers throughout the 21st Century. A wild card is the impact education will play on the ability of these great nations to harness potential into sea power. No matter the technical advances, the jet engine engineering systems, the supersonic weapons or the highest combat systems computing power it will always come down to an individual sailors’ ability to keep a ship afloat and fighting. The young men and women who enter school over the next few years will man the fleets of 2030 and go to sea in even more complex warships. The implementation of education philosophy and policy in the United States, China, and India

⁵⁴ Alan De Brauw and John Giles, *Migrant Opportunity and the Educational Attainment of Youth in Rural China*, (Washington DC: The World Bank Development Research Group Human Development and Public Services Team, 2008), 4.

in the following decades will have a far reaching impact on control of the sea lines, a critical global common for joint forces, through the end of the 21st Century.

Chapter 2

Education Philosophy and Policy

“Laws will be wisely formed and honestly administered...that those persons whom nature has endowed with genius and virtue should be rendered by liberal education worthy to receive and able to guard the sacred deposit of the rights and liberties of their fellow citizens; and that they should be called to that charge without regard to wealth, birth or other accidental condition”¹

Thomas Jefferson

The educational philosophy of a nation is a reflection of its citizens. It is an embodiment of their hopes and dreams, not only for their children but for their nation. Throughout its history, the United States has valued education as the means to ensure that both knowledge and the ideals and responsibilities of democratic citizenship are passed from one generation to the next. These are not unique goals and many nation states have similar educational philosophies. Meeting these goals, however, is much more difficult than just drafting policy or even appropriating funds. It is difficult, if not impossible, to increase the level of education within a nation if the knowledge being taught does not have value for the community or the opportunity cost of sending children to school is too great for families.² This struggle is the real dilemma for developing communities and nations and one that impacts the development of a knowledge military.

The family benefit of education, not the societal benefit, is often the predominant factor in the level and quality of education that children receive.³ This individual decision made by parents, however, is the key for a nation’s ability to participate in the

¹ Julian P. Boyd, ed., *The Papers of Thomas Jefferson*, (Princeton: Princeton University Press, 1950), 526-527.

² Barbara Bruns, Alain Mingat, and Ramahatra Rakotomalala, *Achieving Universal Primary Education by 2015: A Chance for Every Child*, (Washington DC: World Bank Institute, 2003), 32.

³ *Ibid.*, 32.

knowledge military of the 21st Century and its ability to field armed forces. A national education philosophy that emphasizes access and quality of education through secondary school and the determination to institute policy to support the philosophy will be a determining factor in not only sea power but national power throughout the 21st Century.

The vast majority of countries publicly espouse the importance of education for their citizens. The data are difficult to contest; education is a powerful instrument in reducing poverty, hunger, and infectious disease as well as encouraging good governance.⁴ Over the last twenty years, numerous international forums including the 1990 World Conference on Education in Thailand and the 2000 World Education Forum in Dakar have reaffirmed that primary education is a human right. This basic right, however, is far from universal in most of the developing world.⁵ Though in developed countries like the United States primary education is near universal and secondary education is just under ninety-five percent, many developing nations like India and China struggle to provide primary education across genders and regions.⁶ A primary education, however, is not enough to compete for control of the global commons in an increasingly complex world. Through the late 19th and early 20th Centuries, the United States developed policy to support universal education through secondary school resulting in increased social rates of return for graduates. India and China keenly understand the requirement to move beyond primary education and provide secondary and tertiary

⁴ Ibid., 26.

⁵ Ibid., 3.

⁶ Carl Dahlman, Douglas Zihua Zeng, and Shuilin Wang, *Enhancing China's Competitiveness Through Lifelong Learning*, (Washington, DC: World Bank Institute, 2007), 5.

education to increase their regional and world standing.⁷ National philosophy of education, however, means little if policy is not enacted to support attainment through public funding, programs to support families, and increased social rates of return for graduates.

In the United States, India, and China, increased emphasis has been placed on education in general and math and science in particular. Laws and policies in the United States such as the No Child Left Behind Act of 2001 (NCLB) are designed to close the achievement gap with accountability, flexibility, and choice.⁸ Additionally, President Obama's "Educate to Innovate" Campaign for Excellence in Science, Technology, Engineering & Math (STEM) Education is a "nationwide effort to help reach the administration's goal of moving American students from the middle to the top of the pack in science and math achievement over the next decade."⁹ India and China in five year plans for 2007-2012 and 2006-2010 respectively, also detailed policies to increase access and quality of education including math, science, and English studies. India faces an even greater challenge to increase educational standards than China and is more direct in the need for quality education and more ambitious in their goals. The Indian government understands that "in view of the demands of rapidly changing technology and the growth of knowledge economy, a mere eight years of elementary education would be grossly inadequate for our young children to acquire necessary skills to compete in the job

⁷ Ibid., 9. India, Planning Commission Government, "Eleventh Five Year Plan 2007-2012 Volume II Social Sector," (New Delhi: Oxford University Press, 2008), 18.

⁸ *An Act to Close the Achievement Gap with Accountability, Flexibility, and Choice, so that No Child is Left Behind.*, Public Law 107-110, U.S. Statues at Large 115 (2002), 1.

⁹ President, White House Press Release November 23, 2009, "'Educate to Innovate' Campaign for Excellence in Science, Technology, Engineering & Math (Stem) Education," <http://www.whitehouse.gov/the-press-office/president-obama-launches-educate-innovate-campaign-excellence-science-technology-en> (accessed January 19 2010)

market” proposing twelve years of education versus the nine required under the Chinese five year plan.¹⁰ Significant challenges still remain for both countries with the realities of education falling far short of stated policies with average years of schooling 6.35 years in China and only 5.06 in India compared to over twelve years in the United States.¹¹

As infrastructure exists to provide universal access to education in the United States, policies are focused on increasing the quality of education available to every student especially those disadvantaged by socio-economics. NCLB, which garnered overwhelming bipartisan support when it passed Congress in 2001, is a standards-based approach to increasing student performance across key subject areas with special emphasis on improving the academic achievement of the disadvantaged.¹² A comprehensive law, it includes programs from Early Reading First to Advanced Placement that encourage lifelong learning.¹³ The expansive requirements of the act attempt to impact quality of education in the United States through increased funding and accountability of state and local education systems.¹⁴ Federal funding for education has increased by forty-one percent since the NCLB was enacted in 2002.¹⁵ There are numerous conflicting interpretations of test results, but most agree scores have increased for both minority and non-minority students since enactment of NCLB though since all

¹⁰ India, “Eleventh Five Year Plan 2007-2012 Volume II Social Sector,” 18.

¹¹ Carl Dahlman and Anuja Utz, *India and the Knowledge Economy*, (Washington D.C.: World Bank Institute, 2005), 49.

¹² No Child Left Behind Act of 2001 passed in the House of Representatives by roll call vote (384 Ayes, 45 Nays, 4 Present/Not Voting) and in the Senate by roll call vote (91 Ayes, 8 Nays, 1 Present/Not Voting.). *An Act to Close the Achievement Gap with Accountability, Flexibility, and Choice, so that No Child is Left Behind*, Section 1401.

¹³ Ibid., Section 2.

¹⁴ Ibid., Sections 1113-1117.

¹⁵ U.S. Secretary of Education, Department of Education Press Release February 4, 2009, “President’s Budget Strengthens Nation’s Commitment to No Child Left Behind,” <http://www.ed.gov/news/pressreleases/2008/02/02042008.html> (accessed 19 January 2010)

students are performing better a racial gap still persists.¹⁶ Criticism of the law includes that it encourages teachers to “teach to the test” and increase performance not through higher level understanding of the subject areas, but by rote memorization.¹⁷ Teachers, for example, are less likely to use word problems that stress comprehension in favor of multiple choice formula exams that more likely mirror standardized tests. This regression in complexity of instruction, it is argued, could lead to a loss of advantage in critical thinking skills that is essential for innovation.¹⁸ As NCLB matures, it will be important to re-evaluate progress not only in performance of students on standardized tests but also to offset negative unintended consequences.

Federal, state, and local governments, under and in conjunction with NCLB, have initiated dozens of programs to increase quality of education and encourage lifelong learning. Among these initiatives is President Obama’s “Educate to Innovate” Campaign for Excellence in Science, Technology, Engineering & Math (STEM) Education.¹⁹ STEM is a nationwide effort which includes over \$260 million in public-private funding “to move American students to the top of the pack in science and math achievement over the next decade.”²⁰ These initiatives recognize both the importance of science and math education for excelling in a global economy and that the United States has lost a portion of its competitive edge to smaller, more agile education systems in countries such as

¹⁶ Sam Dillon, “No Child Law is Not Closing Racial Gap,” *New York Times* (April 28, 2009), under “Education,” <http://www.nytimes.com/2009/04/29/education/29scores.html> (accessed 2 March, 2009).

¹⁷ John Cloud, “Are We Failing Our Geniuses,” *Time*, (August 16, 2007), under “Opinion”, <http://www.time.com/time/magazine/article/0,9171,1653653,00.html> (accessed March 2, 2010).

¹⁸ Ibid.

¹⁹ White House Press Release 23 Nov 2009.

²⁰ Ibid.

Finland, Republic of Korea, and the Netherlands.²¹ President Obama announced the program as “reaffirming and strengthening America’s role as the world’s engine of scientific discovery and technological innovation... essential to meeting the challenges of this century.”²² It is through comprehensive reform like NLCB and well funded, designed, and administered program likes STEM that the United States is attempting to reassert the importance of education for a growingly more diverse population. Increased learning can be more difficult to meaningfully impact than simply increasing funding or White House press releases. The United States already spends \$12,092 per student for combined primary and secondary education which is fifty-eight percent higher than the Organization for Economic Cooperation and Development (OECD) average, but was below average on math and science literacy during the 2006 Program for International Student Assessment (PISA) exam.²³ An increase in the quality of education that results in a tangible, prolonged improvement will require sustained, dedicated involvement by all levels of government as well as non-governmental organizations, like Parent-Teacher Associations, especially in at risk communities.

In China and India, however, access remains a limiting factor in the expansion of education beyond primary school. Policies, therefore, contend with both issues of expanding capacity and expansive quality issues across multiple instructional areas such

²¹ Stephen Provasnik, Patrick Gonzales, and David Miller, *U.S. Performance Across International Assessments of Student Achievement*, (Washington DC: National Center for Education Statistics, U.S. Department of Education, 2009), 16.

²² White House Press Release 23 Nov 2009.

²³ Andreas Schleicher, *Education at a Glance 2007: OECD Briefing Note for the United States*, (Paris: OECD Directorate for Education, 2007), 12. Stephanie Baldi, Jin Ying, Melanie Skemer, Patricia Green, Deborah Herget, and Holly Xie, *Highlights from Program for International Student Assessment (PISA) 2006: Performance of U.S. 15 Year Old Students in Science and Mathematics Literacy in an International Context*, (Washington DC: National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education, 2007), 1.

as textbooks, teacher quality, standards of learning, and certification requirements.²⁴ The Chinese and Indian governments understand the close linkage of education and the economy and have implemented five-year plans to address a wide range of issues. Education reform in China includes efforts to increase primary school graduation in rural areas, build capacity to realize the goal of nine years of education for all children, provide adult education classes in basic literacy and numeracy, as well as increase tertiary school enrollment in Chinese Higher Education Institutions.²⁵

China's efforts have increased secondary school enrollment by over fifty-five percent since 1990 with special emphasis placed on vocational training as part of the secondary school curriculum.²⁶ There are still, however, daunting challenges for China as it attempts to modernize its education system to meet the needs of a developed population. Significant effort to upgrade and expand curricula, improve support, evaluation, and standards for teachers, and increase equity, quality, and access is required to close the gap with the world's highly developed economies.²⁷ Though China understands the importance of increasing the education level of its citizens, the central government is unwilling to dedicate the required funds to meet policy objectives with only 1.9% of GDP resourced to education significantly lower than developed countries and other countries in the region (see figure 1). If funding is not increased and quality controls placed on local school systems it is unlikely that significant policy changes will

²⁴ Dahlman and Utz, 47. Dahlman, Zeng, and Wang, 9.

²⁵ China, "The 9th 5-Year Plan for China's Educational Development and the Development Outline by 2010," Ministry of Education of the People's Republic of China's Website, http://www.moe.edu.cn/english/planning_n.htm (accessed January 19, 2010).

²⁶ Ibid.

²⁷ Carl Dahlman and Jean-Eric Aubert, *China and the Knowledge Economy*, (Washington D.C.: World Bank Institute, 2002), 23.

be realized in the near term. India dedicates a larger percentage of GDP to education, but its large population of under-educated children makes their challenges even more difficult.²⁸

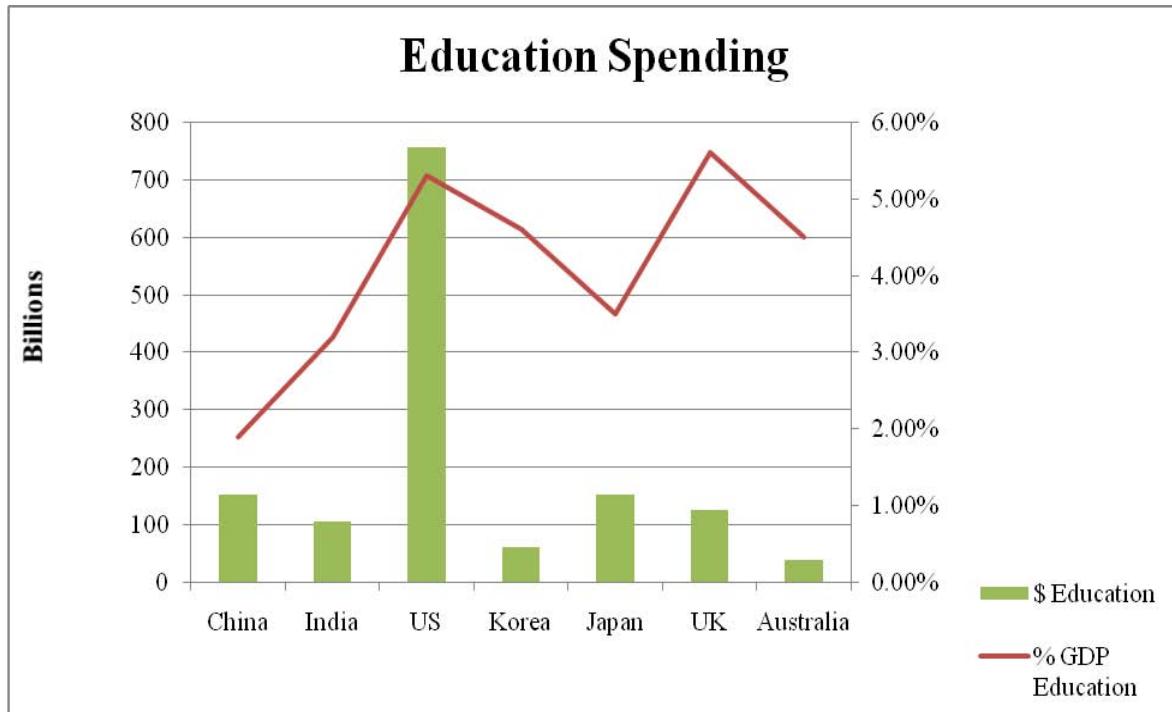


Figure 1. Education Spending.²⁹

India's Eleventh Five-Year Plan addresses a wide range of educational issues to encourage lifelong learning including access, literacy, quality of education, retention, gender inequality, social disparities, and tertiary education including traditional colleges and universities and vocational training.³⁰ Enumerating critical educational issues, however, is not as easy as executing policy to address them. Secondary school education

²⁸ Dahlman and Utz, 50.

²⁹ Central Intelligence Agency World Fact Book, United States, China, and India Merchant Marine Data, <https://www.cia.gov/library/publications/the-world-factbook/geos/us.html>, <https://www.cia.gov/library/publications/the-world-factbook/geos/ch.html>, <https://www.cia.gov/library/publications/the-world-factbook/geos/in.html> (accessed January 19, 2010).

³⁰ India, "Eleventh Five Year Plan 2007-2012 Volume II Social Sector," 1.

is of significant importance both due to an increase in demand and the challenge of expanding access. “Rapid changes in technology and the demand for skills also make it necessary that young people acquire more than eight years of elementary education to acquire the necessary skills to compete successfully in the labour (sic) market.”³¹ India, however, still faces challenges providing elementary education to its diverse population with nearly one-quarter of all under-educated children in the world living on the sub-continent.³²

The challenges of primary education obviously compound the difficulties in realizing the goal of universal secondary education with only 6.6 percent of the population attending secondary school in comparison to 14.8 percent in China. India’s Prime Minister Manmohan Singh, a former economics professor, is keenly aware of the crisis in education, but is concentrating on a top down versus bottom up approach to increasing India’s education system. The data in figure 1 are misleading for both India and China in that funding is heavily skewed to tertiary education with over eighty-six and eighty-nine percent of expenditures respectively on tertiary students.³³ India’s secondary school goals of “(i) universalize access to secondary education; (ii) ensure good quality secondary education with focus on Science, Mathematics, and English; and (iii) aim towards major reduction in gender, social, and regional gaps in enrolments (sic), dropouts, and school retention” will be difficult to realize without changes in funding.³⁴ Along with funding, access to appropriate facilities that address gender equality issues

³¹ India, “Eleventh Five Year Plan 2007-2012 Volume II Social Sector,” 14.

³² Dahlman and Utz, 50.

³³ Ibid., 55.

³⁴ India, “Eleventh Five Year Plan 2007-2012 Volume II Social Sector,” 16-17.

and a large scale campaign to deal with numerous issues impacting quality is also essential to increase educational output. Corruption, faculty shortages and credentials, obsolete teaching aids and syllabi, and common standards are necessary to increase secondary school enrollment and graduation rates.³⁵ National directives, however, cannot effectively impact education without the support of parents and local governments aligned with national policy.

Education, a key to a knowledge military, is often discussed and debated in the seats of government but can be difficult to encapsulate in legislation or influence with policy. With the fanfare of national education policy, it is easy to overlook the importance of local communities and parents on the execution of education. “The evidence is consistent, positive, and convincing: families have a major influence on their children’s achievement in school and through life. When schools, families, and community groups work together to support learning, children tend to do better in school, stay in school longer, and like school more.”³⁶ NCLB has formal, statutory provisions for the participation of parents in their children’s education and proposed changes will increase this participation.³⁷ Though government cannot legislate forced parental participation, it recognizes that it is essential to increasing performance and developing lifelong learning.

India’s Five Year Plan also recognizes the importance of parents in education. Through the development of Parent Teacher Associations in support of universal

³⁵ Dahlman and Utz, 72.

³⁶ Anne T. Henderson and Karen L. Mapp, *A New Wave of Evidence: The Impact of School, Family, and Community Connections on Student Achievement*, (Austin, TX: Southwest Education Development Laboratory, 2002), 7.

³⁷ U.S. Department of Education, Office of the Secretary, Office of Public Affairs, *No Child Left Behind: A Parent’s Guide*, (Washington, DC: US Government Printing Office, 2003), 1.

enrollment, special intervention for disadvantaged groups such as assistance to single mothers, and efforts to impact parental priority to increase female enrollment rates India is engaging parents.³⁸ China's Five Year Plan is conspicuously silent on the role of parents and though socialist market economy and socialist education are referenced ten times parents are not referred to once. Without increased involvement of parents, China will be challenged to increase the social worth of education which is key to increasing enrollment and decreasing recidivism.³⁹ Laws and policies such as the United States' NCLB and India and China's Five Year Plans are worth little if they are not executed by dedicated school administrators, teachers, and parents. The results of these policies can be judged by students performance on standardized tests, critical thought exhibited in discussion and debate, and ultimately in the human capital of a nation and its military. One of the most difficult variables to account for in education policy is demographics. In populous and diverse countries like the United States, China, and India, racial and ethnic minorities with different traditional views on education make it difficult to set national policy. Shifting demographics and other trends in education must be realistically addressed in education policy for meaningful change. The next chapter will review these shifting demographics and their impact on education trends in United States, China, and India as well as their impact on the knowledge military.

³⁸ India, "Eleventh Five Year Plan 2007-2012 Volume II Social Sector," 11.

³⁹ Alan de Brauw and John Giles, *Migrant Opportunity and the Educational Attainment of Youth in Rural China*, (Washington, DC: World Bank Institute, 2008), 9.

Chapter 3

Education Trends in the United States, China, and India

“In a global economy where the most valuable skill you can sell is your knowledge, a good education is no longer just a pathway to opportunity--it is a prerequisite. And yet, we have one of the highest high school dropout rates of any industrialized nation. And half of the students who begin college never finish. This is a prescription for economic decline. So tonight, I ask every American to commit to at least one year or more of higher education or career training. This can be community college or a four-year school; vocational training or an apprenticeship. But every American will need to get more than a high school diploma. And dropping out of high school is no longer an option. It's not just quitting on yourself, it's quitting on your country.”¹

President Barrack Obama

The United States, China, and India are large, diverse countries with shifting trends in education performance. China and India both show positive trends in nearly all areas of education but it is important not to take this out of context. Though both countries have shown excellent progress they could only trend positively from the dismal state of their education systems two decades ago. The United States conversely has shown negative trends in numerous metrics especially in technical fields such as math and science. Everything that is important, however, is not always easily quantified on a standardized test. One of the biggest advantages in United States education system is the inculcating of critical thinking skills in students and these trends remain positive.² Numerous factors such as shifting racial demographics, socio-economics, immigration, migration, and emigration impact these trends in all three countries. How the United States, China, and India respond to these factors will have a significant impact on this

¹ President, Address, “2009 State of the Union Address,” (February 24, 2009), <http://www.presidency.ucsb.edu/ws/index.php?pid=85753> [accessed February 1, 2010].

² Fareed Zakaria, *The Post-American World*, (New York: W. W. Norton & Company, 2008), 193.

Century. Should the United States acquiesce to the rise of the rest?³ This chapter will examine demographic changes and trends in education as they impact the knowledge military, particularly sea power, in the 21st Century.

Demographics, especially race, can be difficult to discuss both due to technical nuances in data interpretation and the historical sensitivity of the topic. It is difficult from a technical perspective because of the way data on Hispanics is collected. The census bureau collects data on both race like White, Black, or Asian and Hispanic origin. Someone whose genealogy traces to Spain would be White with Hispanic origin, someone from Haiti Black with Hispanic origin, and someone from Mexico American Indian with Hispanic origin complicating what diversity or minority mean. For simplicity, this study will examine Hispanics as a group regardless of racial differences so, for example, someone who responded White Hispanic will be grouped as a Hispanic and only those that responded white non-Hispanic will be grouped White. The sensitivity of the topic is due to historical inequities, especially in education. No injustice epitomizes the civil rights movement in the United States better than arguments behind Brown versus Board of Education Topeka, Kansas which ruled that "separate educational facilities are inherently unequal" overturning nearly a century of injustice.⁴ Data are clear, the United States is getting both more diverse and older (figure 2) through this Century, which will impact the requirements of the education system.⁵ The key to

³ Zakaria,1.

⁴ Brown et al v. Board of Education Topeka et al, 347 U.S. 483 (1954).

⁵U.S. Bureau of the Census, *U.S. Population Projections Table Percent of the Projected Population by Race and Hispanic Origin for the United States: 2010 to 2050*, (Washington, DC: US Government Printing Office, 2008).

preventing economic and military decline over the next forty years will be the national response to the changes in these demographics.

Immigration is a major contributor to changes in demographics in the United States. The shift in the Hispanic percentage of the population and the avoidance of even larger increases in median age are a result of immigration. Hispanics are projected to nearly double as a percentage of the United States population by 2050. Additionally, increased birth rates among immigrants are essential to keeping the United States “demographically vibrant” with the work age percentage of the population capable of supporting the economy.⁶ This is a key advantage in comparison to most of the developed world as well as India and China, which have birth rates below replacement level.⁷ Native-born American’s birth rates have been similar to Europe’s over the last quarter century and without immigration the United States’ gross domestic product would have grown similarly.⁸ As first generation Americans and their children become a larger percentage of the population it will be essential to ensure they receive the education that allows them to be full participants in the economy and as important the knowledge military.

⁶ Zakaria, 196

⁷ Ibid, 197

⁸ Ibid, 196

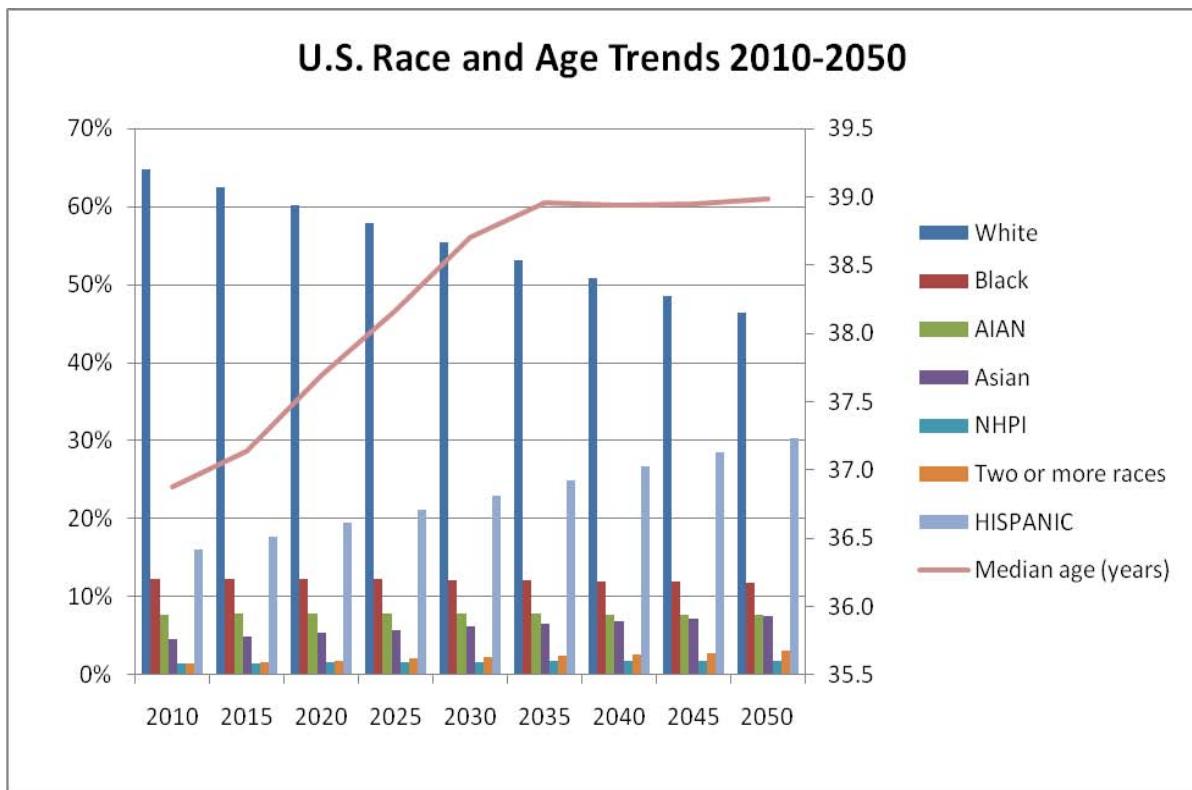


Figure 2. U.S. Race and Age Trends 2010-2050.⁹

The change in racial demographics in the United States also drives changes in socioeconomic. Many new residents emigrated from developing countries with undeveloped education systems and work in service related fields. They come to America for various reasons but many have not seen the positive impact of education in their own lives. Engagement on the importance and social return of education will be essential to growing successful school systems and intelligent citizens. The United States' scores on international tests underlie "deep regional, racial, and socioeconomic variations."¹⁰ Poor and minority students score well below average while "students in affluent suburban U.S. school districts scored nearly as well as students in Singapore the

⁹ U.S. Bureau of the Census, *Percent of the Projected Population by Race and Hispanic Origin for the United States: 2010 to 2050*

¹⁰ Zakaria, 192.

runaway leader.”¹¹ As the population becomes more diverse it will either remain competitive and excel or begin a long decline into irrelevance as an outcome of a whole of population education system.

China and India, though very different cultures, have similar challenges with respect to the impact of demographics on education. Each has made significant progress over the preceding decades in increasing the educational attainment of the relatively affluent areas of their countries. As the largest and second largest countries in the world, however, there are large portions of the population which have not enjoyed these advances. The sheer size of their populations is their greatest challenge.¹² Compounding this challenge are considerable regional disparities between states and provinces, gender inequalities, and low overall educational attainment in the general population.¹³ Many developing countries share similar challenges but it is essential for China and India to overcome these obstacles to maintain the positive education trends they have enjoyed over the last two decades.

China and India, with populations of 1.4 and 1.2 billion citizens, would have challenges providing quality education in any circumstance, but their difficulties are compounded by low per capita gross domestic products which are 133rd and 167th in the world respectively.¹⁴ Low gross domestic product per capita along with low federal

¹¹ Alan S. Brown and Linda LaVine Brown, “What are Science and Math Test Scores Really telling U.S.?” *Bent of Tau Beta Pi*, Winter 2007, 13.

¹² Carl Dahlman and Anuja Utz, *India and the Knowledge Economy*, (Washington D.C.: World Bank Institute, 2005), 70. Carl Dahlman, Douglas Zhihua Zeng, and Shuilin Wang. *Enhancing China’s Competitiveness Through Lifelong Learning*, (Washington, DC: World Bank Institute, 2007), 9.

¹³ Dahlman, Zeng, and Wang, 9. Planning Commission Government of India, “Eleventh Five Year Plan 2007-2012 Volume II Social Sector,” (New Delhi: Oxford University Press, 2008), 19.

¹⁴ Central Intelligence Agency World Fact Book People and Economy Data, <https://www.cia.gov/library/publications/the-world-factbook/geos/ch.html>, <https://www.cia.gov/library/publications/the-world-factbook/geos/in.html> (accessed January 19, 2010).

spending places extreme limitations on building capacity and quality in an education system. These issues lead to low gross enrollment rates, high recidivism, low completion rates, and overall poor quality of instruction.¹⁵ An additional strain on the capacity to provide primary and secondary education is the requirement to provide adult education. In China, roughly 770 million workers are undertaking some type of education or training to acquire new and better skills to keep, gain, or maintain employment.¹⁶ India, though aggressively pursuing educational reform, is home to nearly one quarter of all under-educated children in the world due to the tremendous challenge of educating a billion plus population.¹⁷ Beyond the easily claimed successes in affluent and relatively small and dense school districts, China and India will require nation-wide commitment and increased financial support to realistically provide quality education to such large populations.

Tremendous regional disparities, a result of their large and diverse populations, exist in educational performance in China and India. Enduring issues of haves and have-nots between socioeconomic groups, religious and ethnic minorities, and migratory populations exist in both countries with large differences in the quantity and quality of education received.¹⁸ In China, coastal areas have significantly higher educational attainment and resources and a significantly lower rate of illiteracy, just ten percent in comparison to as high as forty percent in western provinces.¹⁹ Similar conditions exist in

¹⁵ Barbara Bruns, Alain Mingat, and Ramahatra Rakotomalala, *Achieving Universal Primary Education by 2015: A Chance for Every Child*, (Washington DC: World Bank Institute, 2003), 31-35.

¹⁶ Dahlman, Zeng, and Wang, 10.

¹⁷ Dahlman and Utz, 50.

¹⁸ Ibid., 51. Alan de Brauw and John Giles, *Migrant Opportunity and the Educational Attainment of Youth in Rural China*, (Washington DC: World Bank Institute, 2008), 2.

¹⁹ Dahlman, Zeng, and Wang, 14

India between urban and rural areas with the increased difficulty of dealing with a large Muslim minority with differing perspectives on the importance of universal education.²⁰ Additionally, the availability and profitability of jobs within regions also impacts educational attainment. Education beyond primary school is not uniformly or comprehensively funded by public expenditures and can represent a large portion of a family's income. If there is sufficient work and adequate income, a family is less likely to migrate in search of employment and their children are more likely to attend secondary school.²¹ Recent advances in affluent school districts have only aggravated educational inequalities with growing knowledge divides threatening long-term development.²² Gender inequality is also an area of concern throughout China and India but as neither country allows women to serve on combatants at sea it is beyond the scope of this study. The educational disparities that exist throughout China and India are a serious impediment to full utilization of human capital and ability to benefit from large population advantages in a knowledge military.

Compounding every barrier to increasing China and India's ability to participate in a knowledge military is the tremendous gap between current and required education levels. In China, where nine years of education is compulsory, the growing requirement for employment beyond manual labor requires an increase to the average attainment of 6.34 years.²³ In India, twelve years of school is compulsory, but not well supported and

²⁰ India, "Eleventh Five Year Plan 2007-2012 Volume II Social Sector," 1.

²¹ de Brauw and Giles, 2.

²² Carl Dahlman and Jean-Eric Aubert, *China and the Knowledge Economy*, (Washington DC: World Bank Institute, 2002), 71.

²³ Dahlman and Utz, 49.

the average attainment level is an even less impressive 5.06 years.²⁴ In comparison to the Organization for Economic Cooperation and Development (OECD) average of 11.9 years, there remains a significant disparity and obstacle to competing with developed nations.²⁵ Though both countries have made notable advances in education, they still require dramatic increases across the entire spectrum of education to meet the challenges of a developed population and knowledge military.

Significant demographic inequalities and shifting population trends in the United States, China, and India will aggravate the challenges of providing quality education through the remainder of the Century. A growingly diverse country, the United States must respond to these demographic changes to preserve its place as the largest economy and military power in the world. China and India must deal with different but even father reaching challenges to increase the educational attainment of their population to move from developing to developed country. The success or failure of policy changes, impact of demographic shifts, and overall knowledge levels are measured as trends in student performance.

Trends in education, often reported as results of standardized tests across a series of years, are frequently used as an indicator of the level of knowledge of students and of the quality an education system. United States performance across the range of standardized tests including Progress in International Reading Literacy Study (PIRLS), the Program for International Student Assessment (PISA), and the Trends in International Mathematics and Science Study (TIMSS) can most generously be characterized as

²⁴ Dahlman and Utz, 50.

²⁵ Organization for Economic Cooperation and Development, *Educational Attainment by Gender and Average Years Spent in Formal Education, Table C09.1*.
<http://www.oecd.org/dataoecd/56/9/37863998.pdf> (accessed March 2, 2010).

average.²⁶ In PISA, a test of fifteen year olds' ability to apply math and science knowledge to solve realistic problem sets, the United States consistently performs below average and the majority of OECD countries.²⁷ The data are stark, but are they harbingers of future economic and military decline? These trends are not the only measurement of student's performance and similar data dating back fifty years prophesized the collapse of the United States due to the poor educational performance of children.

In the 1950s, it was the superior scientific performance of Soviet students in comparison to the sock hopping young Americans that preceded a science and arms race that resulted in Neil Armstrong on the moon and nuclear powered United States supercarriers at sea.²⁸ In the 1980s, the Japanese were ordained the heir apparent economic superpower as a result of their hard working, superior students only to suffer through a twenty year economic decline.²⁹ Today, it is the Chinese and Indian students, arguably the small percentage of mostly male students that receive greater than an elementary education, that are predicted to bring about the United States decline.³⁰ This is not to discount the importance of these educational trends or to propose to ignore them. They are key indicators of the need for change to ensure the United States remains a leader in

²⁶ Alan S. Brown and Linda LaVine Brown, 14.

²⁷ Stephanie Baldi, Jin Ying, Melanie Skemer, Patricia Green, Deborah Herget, and Holly Xie, *Highlights from Program for International Student Assessment (PISA) 2006: Performance of U.S. 15 Year Old Students in Science and Mathematics Literacy in an International Context*, (Washington DC: National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education, 2007), 5-15.

²⁸ Walt Gardner, "The 'Crisis' of U.S. Education," *The New York Times* (January 14, 2008), under "U.S.," <http://www.nytimes.com/2008/01/14/opinion/14iht-edgardner.1.9196672.html> (accessed March 2, 2010).

²⁹ Gardner.

³⁰ Ibid.

technological innovation. These trends are not the lone indicator of educational attainment for the entire population, however, and should be used as one of many sources in developing courses of instruction to advance higher level understanding.

International standardized tests are administered in math and science in the fourth and eighth grades and to fifteen year olds. The sample for the assessments includes students from all socio-economic and minority backgrounds that represent the country.³¹ The tests differ in that the TIMSS administered in fourth and eighth grade tests basic knowledge and PISA administered to fifteen year olds test synthesis and evaluation.³² Therefore, one cannot extrapolate the data to suggest that positive trends in TIMSS scores will necessarily result in increased PISA scores in the future. Increased knowledge is an essential enabler to apply a concept but students need to be challenged beyond knowledge to mature as critical thinkers capable of applying the knowledge.

Mathematics is a foundation for the application of technology. Only through an understanding of mathematics can one comprehend physics and then synthesize that understanding of physics into practical work in advanced electronics. Through the range of international mathematics assessments, the United States scores from above average for fourth graders to slightly above average for eighth graders to well below average for fifteen year olds.³³ It is important to understand that the assessments used to gauge performance differs between the fourth and eighth graders TIMSS and the fifteen year olds PISA. TIMSS assesses knowledge of specific mathematical topics and cognitive

³¹ Stephen Provasnik, Patrick Gonzales, and David Miller, “U.S. Performance Across International Assessments of Student Achievement: Special Supplement to the Condition of Education 2009,” (Washington, DC: National Center for Education Statistics, U.S. Department of Education, 2009),iii.

³² Ibid., iii.

³³ Ibid., 21, 44.

skills that are linked with curricula, while PISA assess mathematics literacy which is defined as “an individual’s capacity to identify and understand the role that mathematics plays in the world, to make well-founded judgments and to use and engage with mathematics in ways that meet the needs of that individual’s life as a constructive, concerned, and reflective citizen.”³⁴ The participating countries are also different as TIMSS is administered to over forty-five countries across a broad spectrum of development where PISA is designed to assess literacy in the twenty-nine countries in the OECD.

United States students performed in the top quarter of all participating countries for both fourth and eighth graders in TIMSS 2007 including OECD power houses such as Germany and Singapore.³⁵ Fourth graders performed above average in all three mathematics content domains, numbers, geometric shapes and measures, and data display.³⁶ Eighth graders scored above average in two, at average in one, and below average in one, numbers, and chance, algebra, and geometry respectively.³⁷ The top ten percent of United States students did even better scoring above all but eight participating countries for fourth graders and five for eighth graders.³⁸ Additionally, the scores for both fourth and eighth graders increased a statistically significant eleven and sixteen points respectively from 1995 to 2007.³⁹ United States primary school students, based on performance in TIMSS, are receiving the foundation in mathematics that is required for

³⁴ Ibid., 16.

³⁵ Ibid., 34.

³⁶ Ibid., 16.

³⁷ Ibid.

³⁸ Ibid.

³⁹ Ibid., 24-25.

higher level learning. Unfortunately, this foundation does not seem to matriculate in evaluation and synthesis in the essential secondary school years if PISA is an accurate indicator.

PISA assesses beyond simple knowledge of mathematical formulas and instead tests real world application. This is especially concerning considering the United States was outperformed by twenty-three of twenty-nine participating OECD countries in 2006 as well as eight of twenty-seven non-OECD countries.⁴⁰ It is this practical knowledge that is key for participating in a knowledge military and the trend is in the wrong direction. United States fifteen year olds performed on average nine points lower in 2006 than they did in 2003 and even though this change is not statistically significant, it is certainly not improving.⁴¹ The performance of the top ten percent of United States students was no better with the same twenty-three countries outperforming their peers in the United States.⁴² The root causes of the drastic decrease in United States student performance are complex. Some of these causes such as racial and ethnic demographics and socio-economics were discussed previously in this Chapter but as the United States out-spends nearly every country in the world in education it is essential that these funds are put to better use to actually increase learning.⁴³

TIMSS and PISA also assess international students' ability in science at the same grade and age levels as mathematics. Comparable to mathematics, TIMSS focuses on

⁴⁰ Ibid., iv.

⁴¹ Ibid., 29.

⁴² Ibid., 32.

⁴³ Organization for Cooperation and Economic Development, *Context of Primary and Secondary Education: Finance Table A-37-1*, (Paris: Directorate for Education, Education, and Training Policy Division, 2006).

science content knowledge where PISA focuses on cognitive skills and the application of.⁴⁴ PISA also assesses literacy with scientific literacy defined as

an individual's scientific knowledge and use of that knowledge to identify questions, to acquire new knowledge, to explain scientific phenomena, and to draw evidence-based conclusions about science related issues, understanding of the characteristic features of science as a form of human knowledge and enquiry, awareness of how science and technology shape our material, intellectual, and cultural environment, and willingness to engage in science-related issues, and with the ideas of science, as a reflective citizen.⁴⁵

The results of these assessments are similar to the results of the mathematics assessments and lead to the same conclusions and concerns for the ability of the United States secondary school system to produce graduates capable of participating in a knowledge military.

United States fourth and eighth grade students performed in the top quarter of all participating countries in 2007.⁴⁶ Fourth graders scored above average in all three science content domains including life science, physical science, and Earth science. Eighth graders performed above average in three and at average in one, biology, chemistry, Earth science, and physics respectively.⁴⁷ Performance of the top ten percent of fourth grade students, like in mathematics, is even better with only three countries outperforming the United States.⁴⁸ There was no statistical change in performance of United States students from 1995 to 2007 on TIMSS or on their world rank though numerous countries made tremendous strides in decreasing their knowledge gap with the

⁴⁴ Provasnik, Gonzales, and Miller, 32.

⁴⁵ Ibid., 32.

⁴⁶ Ibid., 33-34.

⁴⁷ Ibid., 32.

⁴⁸ Ibid., 33-34.

United States and OECD countries in general.⁴⁹ In science like mathematics, however, the base of knowledge received in primary school did not equate to superior performance as fifteen year olds in PISA and generates the same concerns.

In PISA 2006, United States students were outperformed in science by sixteen of twenty-nine participating OECD as well as six of twenty-seven non-OECD countries.⁵⁰ United States students in the top ten percent did considerably better than the average student ranking tenth among OECD countries with scores great than the average of top ten percent students in all participating countries.⁵¹ The science portion of PISA was significantly revised in 2006 so comparison with previous assessments is not possible. Overall, United States fifteen year olds performed better in science than they did in mathematics especially among the best students. Serious debate and change, however, is required for the United States to make further gains in this essential area.

United States performance on these assessments is well recorded, studied, and deconstructed. How does this performance compare with China and India? Unfortunately, a comparison is not possible as India does not participate in TIMSS or PISA and China only selectively participates.⁵² No other participant in TIMSS or PISA is comparatively as large or diverse as the United States which makes it easy to overstate results. As discussed in this Chapter and the previous Chapter, Chinese and Indian students have shown positive trends across numerous fields of study at all levels of education. It is not, however, accurate to extrapolate this data to compare the underlying education systems

⁴⁹ Ibid., 35.

⁵⁰ Ibid., 40.

⁵¹ Ibid., 41.

⁵² Hong Kong participates as Special Administrative Region of China.

with the United States. Over the last twenty years, both China and India have made tremendous progress, but much more expansive changes need to be made for either country to be able to compete with OECD countries in TIMSS or PISA across the required target population.⁵³

The United States education system might struggle in teaching mathematics and science through secondary school, but it also has one clear advantage. The United States system, in comparison to European and especially Asian schools, emphasizes critical thinking and problem solving. While the United States system is “too lax on rigor and memorization – whether in math (sic) or poetry – it is much better at developing the critical faculties of the mind, which is what you need to succeed in life.”⁵⁴ It is easy to be lost in the negative education data, but why then is the United States still an economic and technological leader? Knowledge alone is not enough to imagine and create outside the paradigms presented in classrooms and textbooks. It is this ability that the United States excels in teaching and which is key to producing so many successful businessmen, scientists, and great leaders. This ability is why the United States remained the world’s leading economy over the last 130 years and it produced nearly three times as many Nobel Prize winners than any other country in the world.⁵⁵

As the United States enacts legislation like No Child Left Behind to increase test scores and global competitiveness countries like Singapore, a perennial powerhouse on TIMSS and PISA, want to change their system to cultivate inventiveness and critical

⁵³ OECD requires assessment participants represent the average population to ensure accuracy and comparability.

⁵⁴ Zakaria, 193

⁵⁵ Ibid., 180. Nobel Foundation, “All Nobel Laureates,” http://nobelprize.org/nobel_prizes/lists/all/ [accessed February 1, 2010].

thinking.⁵⁶ The problem is that teaching critical thinking is hard and difficult to test. Parents that were educated and taught that test scores, especially in mathematics and science, meant everything are finding it difficult to accept curricula changes. When Japan cut its requirements by thirty percent and eliminated Saturday classes to provide more time for interactive learning, parents revolted from fear that their children were not learning enough.⁵⁷ There is an essential balance between the different learning philosophies to produce graduates that understand and evaluate data but also have the critical thinking skills to use that data to imagine alternatives. The best scientific minds of the day thought the world was flat and the earth revolved around the sun, it was only those who thought beyond their classrooms that re-invented the world. Critical thinking is as important as technical knowledge to lead in the modern world and especially in a knowledge military.

How will trends in education impact sea power? The United States military continues to dominate across every warfare area and spends more than the next fourteen countries combined, accounting for nearly fifty percent of global defense spending.⁵⁸ Additionally, it spends more on research and development than the rest of the world combined and it does this on a relatively small percentage, in comparison to previous defense budgets, of gross domestic product.⁵⁹ This funding is possible only because of a strong economy, one that is also heavily dependent on a vibrant education system.

⁵⁶ Michael A Chandler, “Asian Educators Looking to Loudoun for an Edge,” Washington Post, March 19, 2007, <http://www.washingtonpost.com/wpyn/content/article/2007/03/18/AR2007031801160.html> (accessed March 2, 2010).

⁵⁷ Ibid.

⁵⁸ Zakaria, 181.

⁵⁹ Ibid., 182.

Mahan wrote of the connective nature of sea power and economic power and it is equally true today. Education is as important in a knowledge economy as in a knowledge military and the efforts on education reform will similarly impact, for good or bad, future economic and military power. Nero is not quite fiddling on the supremacy of the United States, though natural shifts in relative power are inevitable and welcome. Short of a cataclysmic change in naval affairs, the United States Navy will continue to dominate the seas for the foreseeable future. Education reform that creates curriculum which balances hard knowledge with critical thinking to increase learning and understanding, not just test scores, will be essential for extending that influence into the last half of the 21st Century and beyond.

Chapter 4

Impact of Education on the Knowledge Military

“All this talk about super weapons and pushbutton warfare is a pile of junk. Man is the only war machine. . . Always remember that man is the only machine that can win the war. . . . It's nice to have good equipment, . . . but man is the key. Remember the French Revolution? That battle was won with brooms, sticks, and stones-- by a bunch of angry women. Get a determined bunch of men and women and they will win the battles no matter what the odds or what kind of equipment they use.”¹

General George S Patton, USA

Man is the key to warfare because knowledge is the key to warfare. It is not the smart weapon or latest revolution in military affairs that wins battles; it is the men and women who employ these systems. Technology has not changed the nature of war and Clausewitz' military genius is as essential today as it was in the 19th Century. The technological factors of the conduct of war, however, have changed and require a vastly more educated soldier, marine, airman, and sailor. There are no longer grunt occupation specialties within the services. Every man and woman in uniform uses technology on a daily basis to accomplish their missions. The revolution in naval shipbuilding and the requirements to maintain and operate modern warships are an illustrative example of this change in the conduct of war. This chapter will explore, for illustrative purposes, the technical complexity of modern naval operations and the requirement for advanced training in the Navy, but, the concept is equally essential to the entire joint force.

The 20th Century marked a more dynamic period of change in naval warfare than in any other time in history.² The great naval battle of the First World War, Jutland, was

¹Alan Axelrod, *Patton on Leadership: Strategic Lessons for Corporate Warfare*, (Paramus, NJ: Prentice Hall Press, 1999), 145.

² Phillips P. O'Brien. *Technology and Naval Combat in the Twentieth Century and Beyond*. (Portland, OR: Frank Cass Publishers, 2001), vii.

fought between steam powered surface ships with artillery main batteries communicating via flag hoist. Less than a Century later at the conclusion of the Cold War, the United States Navy consisted of nuclear powered aircraft carriers capable of striking targets hundreds of miles away escorted by AEGIS equipped surface combatants firing super-sonic air defense missiles and striking surface targets a thousand miles away based on satellite targeting data. Nearly every system on a modern warship is dependent on computer systems. Naval power in the 20th Century was focused by the “control and application of naval technology.”³ Engineering, combat systems, weapons, communications, and even the oldest enlisted specialty navigation are all dependent on a sailors’ comprehensive understanding of technology. As the Navy transitioned from sail to steam to computer assisted gas turbine engines, it transitioned to a knowledge military which requires well educated sailors.

The number and design of sails varied on warships depending on their size and mission, but were mainly variations of a theme (figure 3).⁴ Rigging and maintaining the sails was challenging but the seamanship skills needed were largely taught on the job and did not require comprehensive education or training. In comparison, United States surface combatants are now propelled by General Electric LM2500 gas turbine engines (figure 4) capable of producing 33,600 shaft horse power.⁵ Instead of a series of sails, the LM2500

consists of a 16-stage, 18:1 pressure ratio compressor with seven stages of variable stators and inlet guide vanes; a fully annular combustor with externally mounted fuel nozzles, and a two-stage, air-cooled high-

³ O’Brien, vii.

⁴ John Harland, *Seamanship in the Age of Sail*, (London: Conway Maritime Press, 1984), 30.

⁵ General Electric, “LM2500 Marine Gas Turbine Engine,” http://www.geae.com/engines/marine/pdfs/datasheet_lm2500.pdf (accessed March 1, 2010).

pressure turbine which drives the compressor and the accessory gearbox. A six-stage, aerodynamically coupled low-pressure power turbine which is driven by the gas generator's high-energy exhaust gas flow drives the output shaft of the marine gas turbine.⁶

This is only the prime mover within main propulsion, there are a dozen auxiliary systems including cooling and heating, reduction gears and shafting, lube oil, and fuel oil all with independent and inter-connected computer systems which require highly educated and trained sailors. This level of training cannot be received "hands on" and requires a complex training system.

SEAMANSHIP IN THE AGE OF SAIL

Sails and their parts

A Square sail; B jib and triangular staysail; C triangular gaff topsail; D gaff sail; E trapezoidal staysail
a head; b leech; c luff; d stay; e hunt; f mast; g foot;
h peak; i clew; j nock; k tack.

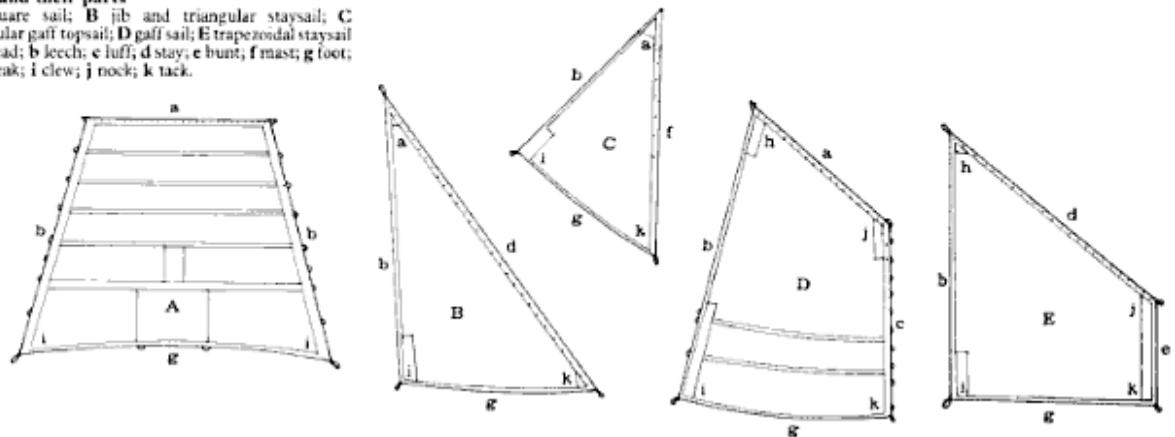


Figure 3. Sails and their Parts⁷

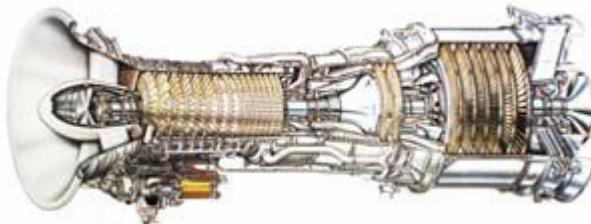


Figure 4. LM2500 Marine Gas Turbine Engine⁸

⁶ General Electric, "LM2500 Marine Gas Turbine Engine," http://www.geae.com/engines/marine/pdfs/datasheet_lm2500.pdf (accessed March 1, 2010).

⁷ Harland, 30.

⁸ General Electric, "LM2500 Marine Gas Turbine Engine," http://www.geae.com/engines/marine/pdfs/datasheet_lm2500.pdf (accessed March 1, 2010).

In turn, this complex training system relies on a well educated input of secondary school graduates. Engineering is not unique and similar if not more drastic revolutions have occurred in every facet of naval technology. Communication by flashing light and flag hoist has been replaced by encrypted satellite radio transmissions, unassisted cannon fire by guided cruise missiles, and celestial navigation by the global positioning system. For a dominant nation to maintain their position as a naval power or a developing nation to displace a more advanced competitor technological superiority is essential.⁹ Though this technology can be bought or stolen it is of little use without the highly trained sailors to maintain and operate it. Of the pillars of a knowledge military, education is the foundation and split pin.

The onset of a knowledge military and the technological revolutions it created impacted navies the world wide but its effects are even more marked in western navies such as the United States Navy. There was much debate in the 1970s on how the United States Navy could best impact Cold War Strategy. The debate was largely between those that sought a mix of low and high technology platforms and those that desired high end platforms alone. Admiral Zumwalt, the Chief of Naval Operations from 1970 to 1974, championed a the low/high mix and was successful in building numerous low technology sea control platforms including the *Oliver Hazard Perry* frigate and *Pegasus* patrol craft.¹⁰ His efforts were countered by those who sought only high technology nuclear aircraft carriers, nuclear submarines, and high end surface combatants capable of sea dominance against a less technologically advanced Soviet Navy. President Reagan's offensive maritime strategy to defeat the Soviet Navy with a 600 ship Navy built around

⁹ O'Brien, vii.

¹⁰ Ibid., 208.

15 heavy-carrier battle groups ended the debate in favor of high technology.¹¹ The naval build up of the 1980s was centered on platforms with “sophisticated computer and control systems...navigation and fire control, tying the fleet together around intelligence and command controls.”¹² These innovations were crucial to victory in the Cold War as well as the foundation for the highly advanced naval platforms in the United States Navy today.

Conversely, the Soviet Navy was built not on a strategy of sea control, but of sea denial. Between 1946 and 1991, the Soviet Union built 394 major surface combatants and 664 submarines, but only seven light weight carriers.¹³ Ship designs were built on 1950s and 1960s technology with main armaments of big, fast, and relatively dumb weapons.¹⁴ The maritime strategy and ship building programs of the former Soviet Navy continue to impact sea power today. China’s anti-access strategy is a sea denial strategy and the People’s Liberation Army-Navy (PLA-N) is acquiring similar platforms and weapons in support of this strategy. Numerous ships in the PLA-N are either decommissioned Soviet ships or built on Soviet designs as are the most effective anti-ship missiles in their inventory.¹⁵ The Indian Navy as well is built on a large percentage of Soviet technology with over twenty-five percent of their fleet built by the Soviet Union or

¹¹ Ibid., 211-212.

¹² Ibid., 212.

¹³ Ibid., 178.

¹⁴ Ibid., 174.

¹⁵ Janes World Navies, “China People’s Liberation Army Navy,” http://search.janes.com/Search/documentView.do?docId=/content1/janesdata/binder/jwna/jwna0034.htm@current&pageSelected=allJanes&keyword=china%20navy&backPath=http://search.janes.com/Search&Prod_Name=JWNA&#toclink_j0010004416 (accessed March 3, 2010).

under Soviet supervision.¹⁶ Both the PLA-N and the India Navy are aggressively modernizing their fleets attempting to build high technology, indigenous warships.¹⁷ Their ability to build these ships and especially to operate independently will depend on their sailors' education and training.

The training of sailors to maintain and operate naval systems is complex, time-consuming, and expensive. All training within the United States Navy, from boot camp and officer candidate training to the Senior Enlisted Academy and Major Command School, is the responsibility of the Naval Education and Training Command (NETC). NETC is the largest shore command in the U.S. Navy comprised of 230 activities and commands and provides training for an average of 35,000 personnel each day. The NETC staff includes more than 19,000 military and civilian personnel located around the world and has an annual operating budget of 1.3 billion dollars. In 2008, NETC provided training to more than 33,700 Marines, 2,200 Soldiers, 2,200 Airmen, 2,200 Coast Guardsmen, and 12,000 international students for an excess of 615,000 total course completions.¹⁸ Increased technology on ships drives increased training requirements. In order to perform well in these exceedingly technical classes sailors need a strong fundamental education. The primary means of determining aptitude of potential recruits

¹⁶ Janes World Navies, "India Navy," <http://search.janes.com/Search/documentView.do?docId=/content1/janesdata/binder/jwna/jwna0070.htm@current&pageSelected=allJanes&keyword=india%20navy&backPath=http://search.janes.com/Search&ProdName=JWNA&> (accessed March 3, 2010).

¹⁷ Janes World Navies, "China People's Liberation Army Navy," <http://search.janes.com/Search/documentView.do?docId=/content1/janesdata/binder/jwna/jwna0034.htm@current&pageSelected=allJanes&keyword=china%20navy&backPath=http://search.janes.com/Search&ProdName=JWNA&#toclink-j0010004416> (accessed March 3, 2010). Janes World Navies, "India Navy," <http://search.janes.com/Search/documentView.do?docId=/content1/janesdata/binder/jwna/jwna0070.htm@current&pageSelected=allJanes&keyword=india%20navy&backPath=http://search.janes.com/Search&ProdName=JWNA&> (accessed March 3, 2010).

¹⁸ Ed Barker, "Naval Education and Training Command Changes Leadership," *Navy News Stand*, August 14, 2009, http://www.navy.mil/search/display.asp?story_id=47619 (accessed March 2, 2010).

and their probability of completing training is the Armed Forces Qualification Test (AFQT).

The AFQT is a combination of scores from tests that are included in the Armed Service Vocational Aptitude Battery (ASVAB).¹⁹ It is designed to determine eligibility for enlistment and match prospective recruits to occupational specialties within the Armed Forces. The AFQT serves to both report to Congress on the quality of recruits, as required by law, and to set service standards based on operational requirements for the aptitude required to succeed in highly technical career fields. Since 1989, the “AQFT consisted of the sum of the standard scores from the Arithmetic Reasoning and Math Knowledge subtests (on the ASVAB) plus twice the sum of the standard scores on the Paragraph Comprehension and Word Knowledge subtests.”²⁰

Congress mandates that no enlistee may come from the lowest ten percentiles – CAT V- and that no more than twenty-five percent can have scores between the ninth and thirty-first percentiles – CAT IV (see table 1).²¹ Individual service standards often are higher than these congressionally mandated minimums as technological requirements drive recruitment strategies. Recruitment of the greatly sought after “high quality”, CAT I-IIIA, varies from year to year based on numerous variables including the economy, availability of college financial aid, and probability of combat deployment. Probability of enlistment actually drops the higher an individual’s scores on the AFQT further

¹⁹ M. Rebecca Kilburn, Lawrence M. Hanser, and Jacob Alex Klerman, *Estimating AFQT Scores for National Educational Longitudinal Study (NELS) Respondents*, (Washington D.C.: RAND, 1998), 5.

²⁰ Ibid., 6.

²¹ Ibid.

complicating the ability to recruit the high quality individuals necessary to conduct sustained combat operations in a knowledge military.²²

AFQT Percentile	AFQT Categories
93-99	I
65-92	II
50-64	III-A
31-49	III-B
10-30	IV
1-9	V

Table 1. AFQT Percentile and Categories

The peace dividends of the 1990s resulted in reductions in the number of recruits required and the ability to accept even higher quality enlistees (see figure 5). The reported erosion of educational standards in the United States has not impacted the ability of the services, especially the Air Force and Navy, to recruit “high quality” enlistees. Even in the large force structures of the late 1980s, with the Air Force and Navy nearly double in size in comparison to today’s force structure, all services including the Army were able to recruit the majority of enlistees from the III-A lower “high quality” category.²³ In response to a major war requiring the rapid expanse of the Armed Services, this data suggests that services excluding the Marine Corps, which has grown in size since 1988, could nearly double in size without a significant impact on the quality of the force.

²² James R. Hosek and Christine E. Peterson, *Enlistment Decisions of Young Men*, (Washington D.C.: RAND, 1985), 22.

²³ Department of Defense, Defense Manpower Data Center, *Armed Forces Quality Test Data*, created February 9, 2010.

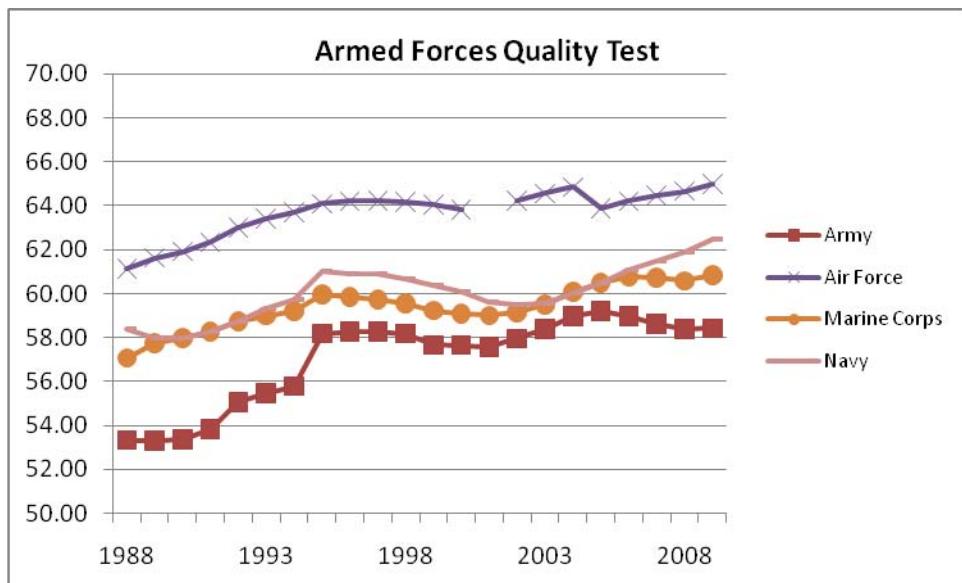


Figure 5. Armed Forces Quality Test Trends²⁴

Man is the ultimate instrument of war and regardless of technology it is the thinking man capable of military “genius” that will be the key to victory. This genius is often thought of in terms of generals and admirals but the individual intelligence of the fighting soldier, sailor, airman, and marine in today’s highly advanced military is equally critical. This advanced technology, as illustrated in naval systems, requires highly educated and trained personnel to ensure units are ready for tasking by joint commanders. To man the fleet with personnel capable of participating in this highly complex knowledge military requires not only an advanced technical training infrastructure but highly educated individuals entering the system from secondary schools. No longer is it possible to learn the art and science of war “on the job,” military personnel must enter the service capable of learning advanced, complex concepts from initial entry into recruit training. The public school system is the backbone of the United States’ ability to execute military operations. The trends in quality data within the Armed Forces (figure

²⁴ Department of Defense. Air Force data for 2001 corrupted and therefore deleted from figure 5.

5) are encouraging but this does not lessen the necessity or urgency to transform the public education to a leaner more agile system to meet both the needs of the military in particular but also the demands of the nation in whole. Without these changes, the United States' knowledge advantage will erode as nations like China and India increase capabilities and output. If this is allowed to occur and the joint forces cedes the knowledge advantage to adversaries, the United States will no longer be able to conduct full spectrum combat operations and will pass into history as a former military power.

Chapter 5

Impact of Knowledge Military on the Joint Force

“Separate ground, sea, and air warfare is gone forever. If ever again we should be involved in war, we will fight it in all elements, with all services, as one single concentrated effort.”¹

General Dwight D. Eisenhower, USA

Knowledge, of one's enemy and oneself, lessens the effects of fog and friction and aids in commander's decision making.² Military professionals understand clearly that knowledge is an enduring requirement for success in combat. Knowledge goes beyond merely the acquisition of information for use in planning and operation execution. Knowledge, across the full spectrum of intellectual behavior is an essential joint warfighting tenet.³ All warfighters, regardless of service, are “cognitive warriors” participating in a joint knowledge military and require a high level of education and training to be effective.⁴ Knowledge Management, Knowledge Dominance, Knowledge Online, Knowledge Now are all every day components of military operations and essential to mission accomplishment. Fast paced, complex joint operations against a peer or near peer competitor, like China, will require the entire joint force. Future battles and wars, and subsequently access to the global commons, will be won or lost based on the

¹ General Dwight D. Eisenhower as inscribed at the Ike Shelton Library at the Joint Forces Staff College.

² Sun Tzu, *Art of War*, (Oxford: Oxford University Press, 1963), 84. Carl Von Clausewitz, *On War*, (New York: Random House Press, 1993), 684.

³ Benjamin S. Bloom, *Developing Talent in Young People*, (New York: Ballantine Books, 1985), 5.

⁴ General James N. Mattis Commander of Joint Force Command, statement to the House Armed Services Committee, on March 18, 2009, http://armedservices.house.gov/pdfs/FC031809/Mattis_Testimony031809.pdf (accessed 31 December 2009), 19.

ability of soldiers, sailors, airmen, and marines to manage knowledge military operations across the entire spectrum of joint warfare.

War with China is neither inevitable nor inconceivable as their influence and military capabilities continue to expand. China's likely immediate goals, in any projected war with the United States, would be the acquisition of Taiwan and the natural resources in the South China Sea. China's increasing belligerence, as illustrated by the *USNS Impeccable* incident in March 2009, in the South China Sea could easily escalate into confrontation.⁵ China's investments in anti-access weaponry would make an immediate large scale naval operation within their contiguous water space highly escalatory. To respond to this confrontation while attempting to prevent large scale war, the United States could conduct an anti-access campaign of its own designed to restrict China's freedom of navigation within its critical sea lines including in the Strait of Malacca. China's "string of pearl" bases in the Bay of Bengal would be a key objective for the Joint Force Land Component Commander (JFLCC) supported by the Joint Force Maritime Component Commander (JFMCC) and Joint Force Air Component Commander (JFACC). Any such operation would require operations across the entire joint force with every facet of the knowledge military operating interconnected.

Amphibious landings, like those necessary to neutralize forward operating bases in the Bay of Bengal, are difficult and require coordination between Component Commanders. Warships assigned to the JFMCC would be required to provide Naval Surface Fire Support during the landing and subsequent inland operations. In a future operation, this would likely be conducted with advanced systems like the electromagnetic

⁵ Tim Reid, "U.S. Ships Head for South China Sea After Standoff," *Times Online*, posted March 14, 2009, http://www.timesonline.co.uk/tol/news/world/us_and_americas/article5898650.ece (accesses 31 December 2009).

rail gun currently under research and development. The sixty-four mega joule rail gun being designed for use on surface combatants would be capable of firing a mach five projectile over 200 miles to within five meters of aim point.⁶ An extremely advanced system such as a rail gun will require an even more highly educated and trained sailor to operate and maintain it. Based on today's education trends, it is easy to predict an operation, such as a joint amphibious landing in the Bay of Bengal, that would fail because of sailors not suitably educated and trained to participate in a knowledge military.

Technology has often driven revolutions in military affairs and provided an advantage in war. Sir Francis Bacon said that "knowledge is power," but Napoleon was probably more accurate that "knowledge is only potential power." The "cognitive warrior" uses knowledge, in all its forms, to achieve military objectives.⁷ From archers to horse shoes, technology has been an advantage and required constant education to meet its potential.

For want of a nail the shoe was lost, for want of a shoe the horse was lost; and for want of a horse the rider was lost being overtaken and slain by the enemy, all for want of care about a horse-shoe nail.⁸

Often quoted this aphorism is as true today, education and knowledge are now the nails that hold the battle and the nation together. If a sailor does not have the education to comprehend advanced technical training, he will not be able to operate his equipment when required. If he is not able to operate his equipment, like an advanced rail gun,

⁶ Zachary M. Peterson. "'Record' Rail Gun Test Today," *Navy Times*, January 31, 2008, http://www.navytimes.com/news/2008/01/navy_railgun_test_080129w/ (accessed March 2, 2009).

⁷ Mattis, 19.

⁸ Benjamin Franklin, *Poor Richard's Almanack*, (New York: Skyhorse Publishing, 2007), 375.

when the call for fire is received then battles will be lost. A warship's failure to support joint operations, because of under-educated and trained sailors, would have far reaching impacts on future wars. Education is fundamental to all military operations. The impact of education and the knowledge military on the Navy pervades every facet of warfighting. This impact, however, is not unique to the Navy and every service and the joint community is increasingly committed to exploiting this essential domain.

The Air Force, arguably the most high technology focused of the services, recruited the majority of the "high quality" recruits based on the Armed Forces Qualification Test (AFQT) in 2008. The Air Force was also the first to develop tools for the easy access and sharing of knowledge across the service. Air Force Knowledge Now (AFKN), a web based portal, marked its tenth anniversary in May, 2009 and led to the Army and the Navy developing similar systems. AFKN started as a simple information management tool for databases and lessons learned but it has matured into an interactive education and training site with over 320,000 users accessing twelve million pages a month.⁹ The Army and Navy have had similar success providing education and training on topics as diverse as history, personal hygiene, and cultural training to its members via web-based, knowledge on-line portals. These tools and the knowledge management and dominance allow the advanced networking of services and the synergizing of efforts. Knowledge, acquired by education, training, and experience, will be a determining factor in future joint operations.

World War II made it clear that all future warfare would be joint warfare and it is equally clear in today's technologically advanced military that all warfare is knowledge

⁹ Daryl Mayer, "'Air Force Knowledge Now' Turns 10," Air Force Official Webpage, posted May 18, 2009, <http://www.af.mil/news/story.asp?id=123149714> (accessed 30 December 2009).

warfare.¹⁰ The success, or failure, of future military campaigns will be dependent on all services' ability to operate together in a knowledge military. If the Navy is incapable of sea control because its sailors lack the education and training to operate and maintain advanced warships then the joint force will fail. Without a dominant Navy, the expeditionary capabilities of the United States would be greatly diminished and the nation will suffer. One can imagine a future battle where soldiers and marines die ashore and the campaign fails because the Navy was not be able to provide required support for the want of education. If national policy to reverse negative education trends is not successful, there will be serious consequences for the joint force. These consequences range from reductions in the quality of soldiers, sailors, airmen, and marines to the ultimate outcome of future wars. Now is the time to re-invest the nation in education to ensure the Navy, and the joint force, is capable of ensuring access to all global commons in support military readiness and economic prosperity.

¹⁰ Eisenhower.

Conclusion

Education, the process by which knowledge is passed on between individuals and generations, is the cornerstone of a knowledge military. Joint military operations conducted by developed nations like the United States, India, or China are dependent on highly technical weapons and well educated personnel to employ them. A country cannot expect to successfully employ military forces without an effective universal education system to provide prospective recruits with the cognitive foundation to excel in a knowledge military. India and China are in the midst of great educational reform demonstrating impressive gains over the last few decades.¹ The United States' performance on international assessments, despite increased funding to education, remains lackluster.² Reform, like the No Child Left Behind Act, though imperfect, is essential to increase United States students' level of education especially in the application of mathematics and science.

As President Obama develops revisions to the original No Child Left Behind Act, it is essential to set realistic goals taking into account realistic funding. Like in politics, education is ultimately local. The Federal Government, unlike in India in China, cannot directly set the standards used to measure student performance though they attempt to influence them through funding. Individual states set standards of learning and under the

¹ India, Planning Commission Government, "Eleventh Five Year Plan 2007-2012 Volume II Social Sector," (New Delhi: Oxford University Press, 2008), 18. China, "The 9th 5-Year Plan for China's Educational Development and the Development Outline by 2010," Ministry of Education of the People's Republic of China's Website, http://www.moe.edu.cn/english/planning_n.htm (accessed 19 January 2010).

² Stephanie Baldi, Jin Ying, Melanie Skemer, Patricia Green, Deborah Herget, and Holly Xie, *Highlights from Program for International Student Assessment (PISA) 2006: Performance of U.S. 15 Year Old Students in Science and Mathematics Literacy in an International Context*, (Washington DC: National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education, 2007), 1.

current provisions is often setting too many with the bar too low in the most important.³ Virginia assesses standards of learning in the essential subject of science, mathematics, English, and history/social studies, but publishes additional standards for eight other subjects including fine arts and health. Curriculum developers need to make difficult decisions to balance limited resources to focus student time and effort on subjects that prepare them for participation in a knowledge world. The responsibility for other, less essential subjects would be placed back on parents or other institutions funded through private means. There is room for non-core subjects, which develop critical thinking skills, but these subjects should be integrated in a synergistic fashion into a comprehensive, mutually supporting curriculum.

India and China have significant advantages in the development of military power, especially sea power, through the remainder of the century. Across Mahan's characteristics of sea power, India and especially China are particularly fortunate in geography and population. The biggest advantage the United States enjoys, however, is in its education system though this advantage is waning. The United States' ability to lead in a knowledge military will play a crucial if not deciding role in the course of military operations through the remainder of the Century. The ability of the United States Navy to maintain the sea lines, especially in the Indian Ocean and South China Sea, for free trade will have a tremendous impact on the future of the global economy. The ability to lead in the knowledge military is dependent on education and education reform. Significant effort and resources are dedicated to this reform, but only hard work among educators and dedication among parents will determine if these reforms are

³ Alan S. Brown and Linda LaVine Brown, "What are Science and Math Test Scores Really telling U.S.?" *Bent of Tau Beta Pi*, Winter 2007, 16.

successful. A back to basics effort on education is capable of re-invigorating the education system to ensure the United States remains a leader in innovation and knowledge military operations. The foundation and desire for the required reform exist, but only time will tell if local government and individual teachers, parents, and students are willing to put in the hard work to make these desires a reality. The results of these decisions made by individual citizens are no less important than the future of the nation for as Thomas Jefferson believed “if a nation expects to be ignorant and free, in a state of civilization, it expects what never was and never will be.”⁴

Recommendations for Future Study

This study concentrated on only one pillar of the knowledge military, education. The additional pillars, innovation and intuition, research and development, and industrial infrastructure are also essential to conduct knowledge military operations. Sea power was used to illustrate a historical foundation of military operations and the growing technical requirements of warfare. This study could have easily focused on the knowledge military requirements of air or land power. Future research that studied all pillars of the knowledge military across the entire spectrum of joint warfare would significantly contribute to the body of knowledge. This study, however, would require a broader focus than is available during a master’s program and best be the subject of doctoral level research.

⁴ Jennings L. Wagoner, *Jefferson and Education*, (Chapel Hill: The University of North Carolina Press, 2004), 14.

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